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FUNDAMENTAL FACTS RELATIVE TO THE STUDY OF THE VERTEBRÆ IN INDUSTRIAL ACCIDENT CASES[1]

By ARIAL W. GEORGE, M.D., and RALPH D. LEONARD, M.D., BOSTON

DURING the past eleven years we have been obliged, from the type of our work, to become interested in the vertebræ, for the reason that we have acted not only as impartial physicians for the Industrial Accident Board in the State of Massachusetts, but also have had the opportunity to study a large number of cases of injury and disease of the vertebræ referred to us by various insurance companies. This industrial accident work necessarily opened up a new field of study differing in a good many ways from the study of the private patient.

We soon came to realize that in industrial accident work the first objective was not only to determine as accurately as possible those changes, if any, which were the direct result of an injury, but also that the type of treatment might depend to a great extent upon this opinion. Again, closely allied with diagnosis and treatment was the question of immediate and future compensation. Consequently, we came to appreciate that the question of *compensation* was based more or less on the opinions passed by roentgenologists. We found very early in this study that theoretical diagnoses, which were not based upon known facts, or facts that were not easily demonstrable by the X-ray, led into difficulties, not only for ourselves but for the insurance companies, and eventually the Industrial Accident Board.

Over this period of time we have gone through many phases of the work and many changing opinions, struggling to the best of our ability with apparently a difficult problem. We early realized the absolute necessity of giving opinions based on the X-ray studies, which were accurate and which could be proven and substantiated by facts and which were not theoretical. To accomplish this, it became necessary for us to classify our knowledge of the various spine conditions, normal or otherwise, visible in the X-ray. These observations may be simply grouped as follows:

1. The normal vertebra, including the many and varied anatomical variations;
2. Chronological, occupational or postural changes, which include scoliosis and hypertrophic changes;
3. The many changes due to remote and recent injury;
4. The chronic diseases, such as tuberculosis, arthritis, bone tumors and syphilis.

(1) Notwithstanding the many opinions that have appeared in the literature in recent years to the contrary we believe that we can establish a normal vertebra as a standard for our study in the adult. This

[1]Read in part at the annual meeting of the Radiological Society of North America at Rochester, Minnesota, December, 1923.

FIG. 1.—This key plate has been numbered to indicate the various parts of the vertebra which are of diagnostic significance, and in a study of the fifth lumbar vertebra these parts should have special consideration.

1. Anterior superior border of the fifth lumbar vertebra. 2. Posterior superior border of the fifth lumbar vertebra. 3. Lamina. 4. Spinous process of the fourth lumbar vertebra. 5. Spinous process of the fifth lumbar vertebra. 6. Inferior articular process of the fourth lumbar vertebra. 7. Superior articular process of the fifth lumbar vertebra. 8. Inferior articular process of the fifth lumbar vertebra. 9. Superior articular process of the sacrum. 10. Anterior inferior surface of the fourth lumbar vertebra. 11. Anterior inferior border of surface of the fifth lumbar vertebra. 12. Posterior inferior surface or border of the fifth lumbar vertebra. 13. Posterior inferior border of the fourth lumbar vertebra. 14. Anterior superior border of the first body of the sacrum. 15. Posterior superior surface, or border, of the first body of the sacrum. 16. Superior iliac synchondrosis. 17. Inferior iliac synchondrosis. 18. Spinous process of the sacrum. 19. Posterior superior spine, or articular surface of ilium articulating with the sacrum. ss. Spinous process of the sacrum. tp. Transverse process.

opinion is based upon a review of at least ten thousand cases, with this object in mind. This has been accomplished by a careful analysis of the vertebræ as it appears in the gastro-intestinal examinations, the genito-urinary tract examinations, and in the special study of the vertebræ to determine the effect of injury and disease.

During our service in the army a very good opportunity arose to make further investigation, particularly of the normal. During this period a large number of individuals between the ages of twenty and thirty were examined and from this series one hundred cases were selected, which we considered as normal in accordance with

Fig. 2.—See Fig. 1, Key Plate.

our understanding of the normal at that time. Tracings were made particularly of the fifth lumbar vertebra, its articulation with the sacrum; the sacrum and its articulation with the innominates. From these

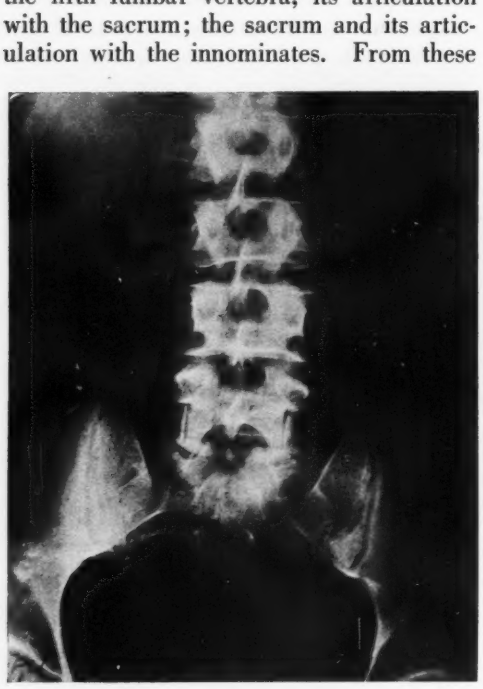

Fig. 3.—As far as can be determined, a normal vertebra. This illustrates our conception of the normal second, third, fourth and fifth lumbar vertebræ, including the sacro-iliac region. It will be noted in this instance that the articular processes of the sacrum and the fifth lumbar vertebra are in such position that they are clearly visible. Occasionally, one will show clearly and the other will not. This is an anatomical variation and has no significance.

tracings a composite tracing was made, which represented the average of all of these plates. This, unquestionably, determined the normal average size of the fifth lumbar vertebra within the ages specified above, especially of the body; its relations to the fourth lumbar vertebra and the sacrum, the size, shape and position of the transverse processes, the angle and shape of the lamina and spinous processes, the relation of the body as a whole to the sacrum, the amount of articulation of the average iliac synchondrosis and the many details that go to make up this region.

From this final composite tracing a skeleton, which was as normal as could be obtained for the age of the cases examined, was disarticulated and re-articulated to represent the average normal. This skeleton and the plates made thereof represent what we determined from the tracings to

Fig. 4.—Normal lateral view. Original films show spinous process clearly. The angle of the sacrum is a little more acute than the average normal. This may eventually prove to be a source of symptoms under certain conditions.

be the average normal. We were obliged to build up the transverse processes to represent the average size by the use of lead foil, and also to demonstrate the extreme and mean angle of the average. We were also obliged to place lead foil along the anterior superior and inferior margins as well as the posterior superior and inferior margins of the bodies to determine these borders accurately when the plates were made.

This became what we have termed our "key plate" and represents, at least in our minds, the average normal. (See Figs. 1 and 2.)

In the large series of plates made in this study many congenital anomalies appeared. Though all of the anomalies that might occur in this region were not found, yet a sufficient number were found to allow a classification of the common anatomical

variations. In our opinion these anatomical variations, unless they be true spina bifida, or a very definite anomaly involving several of the vertebral bodies, should not give rise to confusion in so far as the result of injury or disease is concerned. It has been our opinion that they should be considered under the normal. We feel that no stress or special reference should be made in any way in so far as reports are concerned.

Fig. 5.—Bifid, or non-fusion, of the spinous process of the fifth lumbar vertebra. In our opinion, this is of no significance; it is an anatomical variation.

However, there are some congenital anomalies which we believe are worth emphasizing. Spina bifida when it appears in the adult may be found in any region of the spine. The two common locations in which this variation appears are at the level of the cervical dorsal region and the lower lumbar region. These changes are uniformly characteristic and are found in one or more of the bodies, usually in two bodies. Sometimes the bodies are flattened; other times the bodies are deformed, wedge-shaped, split or fused. Usually, in a true spina bifida a cleft appears. With a true spina bifida there are always changes in the lamina and spinous process; occasionally changes will be found in the transverse processes.

Fig. 6.—Lateral view of normal upper cervical region with lines drawn.

One finds mention in the literature of the bifid spinous process of the fifth lumbar

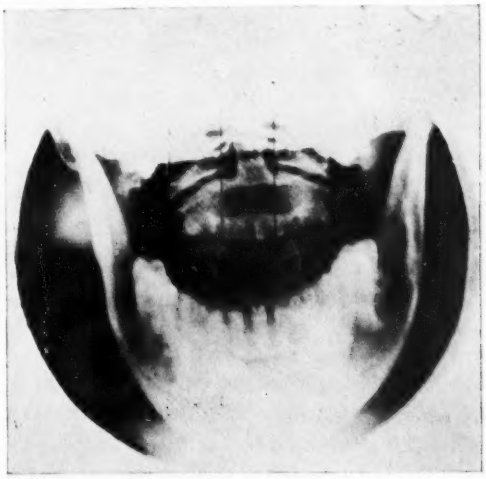

Fig. 7.—Antero-posterior view of case in Fig. 6 and also illustrating the line method.

vertebra and it has been studied and described as "incomplete spina bifida." The writers have not felt willing to agree that this lack of fusion or bifid spinous process of the fifth lumbar vertebra is of

Fig. 8.—Note the change from the normal in the shadow produced by the pharynx and retropharyngeal structures, and the relation of the skull and atlas to the axis.

any clinical importance. We do not believe that the term "incomplete spina bifida" should be applied to this anatomical variation and hesitate to use it. Though it may be an academic question, and one which is not easily proven, we do not feel that this type of spinous process when it appears as the only variation to a given body bears any analogy to true spina bifida. (See Fig. 5.)

The bifid spinous process of the fifth lumbar vertebra is probably the most common single anomaly that we find, and though we may not be able to prove this statement conclusively, we have always been of the opinion that this change from the normal gives rise to no symptoms, should never be reported as such and should never be confused with the changes due to injury.

Another very frequent anomaly is the sacralization of the fifth transverse process,

Fig. 9.—In a general way, our conception of the occupational or postural changes in a man of sixty years of age with very general hypertrophic changes. This is a condition of long standing and has no relation to recent injury.

either unilateral or bilateral. It has been in the rarest of instances that there has been any thought that symptoms should arise from these anomalous changes. Of course, these congenital variations should be recognized and kept in mind, but they should not lead one into giving an opinion that these changes are the cause of symptoms referable to injury, or independently a source of symptoms.

One of the least important of anomalies, but one that has caused a considerable amount of error in diagnosis, is the rudimentary transverse process or rib that sometimes appears from the twelfth dorsal and first lumbar. With injury in mind,

one might be led into the belief that if this condition is unilateral, though it is almost always bilateral, this separation means a fracture, especially if injury occurs at this point. It is a very easy matter to determine this by careful study of this particular vertebra.

Fig. 10.—Illustrating our conception of the first type of fracture (according to classification), a simple crushing or compression fracture of the superior surface of the lumbar vertebra. In our opinion, these changes will always be present throughout the life of the individual to a varying degree.

In the above, we have covered very briefly the more common congenital variations found in the vertebræ, which are not the result of injury or disease. These changes should be noted—perhaps, for the moment, classified. They should be thoroughly understood so that one will not be led into error and make special reference of same in his report. The knowledge of these changes should form a basis for the study of the vertebræ.

In other words, it is our custom to make a mental note of these various changes, but we never incorporate these facts in a report on a case in which we are trying to determine the result of injury or disease.

(2) The second consideration in the study of the vertebræ, and it is of the utmost importance, is the chronological, occupational and postural changes. By chronological change we mean that the vertebræ change in appearance just as other parts of the human anatomy may change; just as an individual grows older in general appearance, so do the vertebræ.

The laboring man, who has done heavy lifting and pushing of heavy objects throughout the period of his working life, is muscular and of large physique, will in almost every instance have changes which differ from the individual who has occupied a desk position or led a sedentary life. There will be structural changes in the spine, such as varying degrees of scoliosis, and due to this structural scoliosis, will be found changes of individual bodies, or of all the bodies. More important perhaps is the fact that with these changes will also be found hypertrophic changes on the margins of the vertebræ. These changes are many times confused with the changes due to injury or disease. (See Fig. 9.)

To us, the most important phase of the entire subject is to understand and recognize the above changes. We feel that many errors of diagnosis have been made relative to these changes, or at least they have added a confusing factor in diagnosis. These changes have frequently been looked upon as the result of injury. If we could eliminate from the study of the vertebræ, chronological, occupational or postural changes and these hypertrophic conditions, the study of the vertebræ would be a very simple matter. The various phases of injury, such as fracture or dislocation, and the more common diseases, are as typical in the vertebræ as they are in any other portion of the osseous system.

We use the terms "occupational" and "postural" synonymously, though this state-

treatment and there is a greater possibility and probability of persisting and possibly permanent neurological symptoms. Again, there is a serious question of return of function and a more serious, at least doubtful, prognosis for future usefulness.

Fig. 14.—An example of what we consider to be Kummell's Disease. It will be noted that there are no morphological changes pertaining to the vertebræ except that of shape. None of the changes are present which would be in evidence as the result of a previous compression fracture. In our opinion this is entirely a postural or occupational change and not the result of injury.

The above are the salient features of industrial accident work, and from our experience the point of view from which interpretation must be considered. You are expected to answer questions through your interpretation as definitely as it lies within the power of the X-ray to do so. Unquestionably, the opinion of the roentgenologist and his diagnosis have a very serious bearing upon the question of compensation, which involves the future of the individual.

This classification should apply not only to the medical consultant in industrial accident work, but also to the legal profession and the laity, who comprise accident boards, boards of directors and commissioners in their determination of the whole question of compensation insurance. A roentgenologist's opinion that cannot be justified by the findings when studied by the X-ray is a dangerous and costly opinion in industrial accident work.

One fundamental differential observation has been established from our own experience in the study of injuries of the vertebræ. Irrespective of the severity of the fracture or dislocation, or the amount of morphological changes in the body or bodies, we have as yet in no instant found complete obliteration of the intervertebral space. Never have we found fusion of bodies resulting from injury of one or more vertebræ, provided the case has been examined in the antero-posterior and lateral diameters. Narrowing of the intervertebral space will appear, but as time goes on, with healing and regeneration of the parts, the space is never obliterated and never ankylosed completely. There may be apparent ankylosis from the bridging of new bone from one body to another, but we are speaking of complete fusion of two bodies, which eventually become as one without evidence in the X-ray of any sort of an intervertebral space.

The great percentage of cases show, first, fracture of the body; second, fracture of the transverse process, and third, fracture of the lamina and spinous process. Any portion of the spine may be fractured, from the atlas to the coccyx.

It is only in very severe injuries of the pelvis that we find fracture of the body of the fifth lumbar vertebra, though quite frequently with severe direct violence we see fractures of the transverse process of the fifth. We have no record in our series of a case of compression or comminuted fracture of the body of the fifth lumbar vertebra. This must partly be due to the fact that the fifth is so well protected by the innominate bones. Fracture produced by indirect violence is referred to the upper

lumbar or lower dorsal regions, which regions are the common sites of fracture.

For example, fractures of the transverse processes of the lumbar vertebræ are, as a rule, due to either extreme flexion or extension of the vertebræ, rarely by direct violence. Unquestionably, many compression fractures of the lower dorsal and upper lumbar vertebræ are due to indirect violence.

It has been the writers' privilege to have made a special study regarding fracture and dislocation of the upper two cervical vertebræ, the atlas and axis. It may not be out of place to summarize this already published observation on this particular region. This method of study has been of inestimable value to us, not so much in recognizing the gross fracture or dislocation, but because we have a method which, with a little effort on our part, could be explained to the laity and understood by the laity, such as a jury. Behind this method there are certain anatomical facts, which make the method definite and, one might almost say, exact.

If an exposure of the upper cervical region is made in the true lateral position, which includes the skull, atlas, axis and third cervical vertebra, one will find that the pharynx is definitely visible and that the retropharyngeal structures are plainly outlined and are parallel to the vertebral or anterior border of the atlas and axis. (See Fig. 6.) (See page 201.)

If an imaginary line is drawn from the anterior tubercle to the anterior border of the body of the axis and a similar line drawn from the posterior portion of the odontoid process to the posterior portion of the body of the axis, these lines will be practically parallel and will include in the upper portion the anterior tubercle and the odontoid process and in the lower portion the body of the axis. If another line is drawn from the anterior portion of the posterior tubercle of the atlas to the anterior portion of the spinous process of the axis, one will find that this line is not parallel to the two lines mentioned. The reason for this is that the neural canal of the atlas is larger in all diameters, especially the antero-posterior, than the axis. The axis will be found larger than the third. The third, fourth, fifth and sixth cervical vertebræ will be found to be of uniform size, provided accuracy of technic is carried out. With the least degree of dislocation forward of the skull and atlas, the third line will change in its relation to the other two lines and, as the dislocation is anterior, these three lines become parallel. If these other two lines are drawn, they will be found not to be parallel to each other.

This method, as far as the lateral aspect of the skull is concerned, very definitely establishes the degree of dislocation, almost to a mathematical certainty.

In the antero-posterior view, when plates are made through the mouth, lines may be drawn from the external border of the articular process of the atlas to the articular process of the axis on the right and also on the internal aspect of the process of the atlas and in the same way to the axis on both sides. We then have four parallel lines. In the center, we find the odontoid process. These lines will be practically of equal distance one to the other. (See Fig. 7.) (See page 201.)

It has been found from very careful study that as long as the head and shoulders rest upon the table one cannot produce obliteration of the space between the processes. When obliteration appears in either one or the other, or both, unless disease has occurred, this is positive proof that there is a displacement of the skull and atlas upon the axis. With fracture of the anterior arch in the antero-posterior view, there will be sufficient displacement, though slight, to alter the parallel lines. If fracture of the posterior arch occurs, a similar picture will be found. It is not always possible to differentiate between fracture of the anterior arch and fracture of the posterior arch in the antero-posterior view. However, one can determine fracture of the posterior arch from the lateral view, which

is a very rare occurrence, but one cannot determine fracture of the anterior arch in the lateral view, as a rule.

There is one type of case which must be mentioned under the heading of fractures, and that is Kummell's Disease. In 1891, and many times since, Kummell has described a condition, which he has designated as "rarefying osteitis of the vertebræ," which he claims occurs in the vertebræ following an injury, but at the time of injury no morphological changes appear in the vertebræ under examination. As time goes on, the body changes in shape, especially along its vertebral border, by becoming wedge-shaped, with the apex of the triangle along the vertebral border.

We have found a great number of cases of this description and for a long period of time have agreed with Kummell that this represents the end-result of injury. However, when we have tried to place these cases in our classification, we found that they were inconsistent with our classification. On very careful study, we found that they did not show any changes in the body, which represented compression fracture, the comminuted type of fracture or dislocation. Aside from the shape of the body, the body was absolutely normal in detail.

In our experience, this condition appeared in the older individual, past fifty years of life, and a great many times in the portion of the vertebræ where a curve, due to posture, was most acute, and we have come to feel that these changes are not necessarily the result of injury, but probably represent postural changes.

Kummell has not proven, at least to our satisfaction, that at the time of injury the bodies were normal and later show the changes that he describes and as the end-result become permanently wedge-shaped. He later describes this condition as "post-traumatic osteitis" and considers the progressive wedging of the body due to trophic changes.

It is our opinion at the present time that this change is usually not due to a previous injury; at least, the injury must have been of remote origin, perhaps dating back to earlier life. The vertebræ show no evidence of compression; there are no changes incident to a healed fracture; there is no deformity characteristic of a comminuted fracture. Furthermore, they usually occur in the aged with structural scoliosis with definite occupational and postural changes.

SPONDYLOLISTHESIS

Spondylolisthesis is a very interesting condition, not infrequently found, and, from our point of view, the etiological factor is rather obscure.

For example, a man sustains an injury. After the immediate symptoms of lameness and stiffness of the back have cleared up, the individual returns to his former work and later, because of symptoms which consist of inability to stoop or lift, comes to us for examination. At this time, we find a definite displacement of the vertebræ, especially of the fifth lumbar upon the sacrum anteriorly. This gives rise to the question, "Is this a congenital anomaly or developmental condition, or the result of the alleged injury?" In other words, is it not true that a certain number of cases appear in which this change has been present since early life?

The writers have one case of spondylolisthesis in mind in a seven-year-old child, without a history of injury.

Another case is that of a young man, who drove an ambulance in France. He had always complained of his back more or less as a boy and young man, but never had very definite symptoms until his return from service. On examination, he was found to have almost complete dislocation of the fifth lumbar vertebra on the sacrum. In looking up his record of X-rays made before he went to France, it was found that he had had several X-ray examinations, and in a careful study of the old plates, the condition was practically the same as found in the later X-rays. As far back as the X-ray examinations went, the amount of dislocation was permanent. In other words, the study in this particular case would seem

to point to the fact that an individual can have this amount of dislocation and not be handicapped to any great extent. On the other hand, there are cases that, with a definite history of trauma, such as being struck by a bale of cotton, or an accident which incurs a similar amount of trauma, show dislocation as an end-result.

With a case presenting itself for examination for an alleged industrial injury, our procedure to-day would be to state the condition as we actually found it and not try to determine whether this dislocation arose in the course of employment or alleged injury, or whether it antedated the alleged injury.

In view of the fact that the workman is entitled to compensation, our effort and attitude is not to theorize in regard to the etiological factors in the production of this condition, but to make a positive or negative diagnosis. Until the time comes when a group of workmen are examined in the course of securing employment, and later one of these individuals after an injury is found to have spondylolisthesis, then and only then will we be able to determine definitely whether this condition is produced by injury, or whether it is of congenital origin, or at least of early development.

A discussion of the vertebræ in reference to industrial accident work cannot be made without speaking of so-called "sacro-iliac dislocation." Without exception, in our opinion, there has been more harm accomplished, especially in this industrial work, by the use of the term and diagnosis "sacro-iliac dislocation" than through the use of any other term or diagnosis contained in the medical literature. The diagnosis is based entirely upon clinical evidence and with the least positive X-ray evidence so far as the sacro-iliac synchondrosis is concerned.

When we consider the sacro-iliac synchondrosis or joint, we must realize that we are dealing with the strongest and largest joint in the body. Throughout the period of years that this diagnosis has been made, only in rare instances have changes been found indicating dislocation, except in cases in which there is a dislocation which has arisen from violent, external trauma. It has been the writers' privilege to see many cases in which the dislocation of

Fig. 15.—Case mentioned in text in which tuberculosis occurred sixteen years previous to this X-ray, which shows complete fusion of two bodies without new bone formation, or any change except complete fusion.

either one or both synchondroses was one inch from its normal articulation. The sacrum can be dislocated and it may be fractured as any other bone found in the body, but it is only as a result of direct and extreme violence.

It has seemed to us a stretch of the imagination to think for a moment that a man in the act of stooping or lifting can receive a dislocation of this joint. Throughout a period of fifteen years' study of this particular region, we can recall only four cases with a history of simple stooping or lifting that presented any changes whatsoever, that would warrant an opinion that there was a dislocation. We believe that the consensus of opinion by all roentgenologists who have had any experience whatsoever will to a great extent substantiate our opinion. It

would seem after all these years in which this diagnosis has been used that some definite diagnostic signs would have been found in the X-ray to establish this diagnosis, but to the contrary, practically nothing of im-

Fig. 16.—Lateral view showing similar condition as Fig. 14. X-ray diagnosis was compression fracture. This is a healed case of tuberculosis.

portance has been offered. In spite of these facts, the largest percentage of cases that are referred to us with symptoms referable to the lower back and sacro-iliac region are clinically considered as sacro-iliac dislocation, and we are expected to find changes which will substantiate this opinion of so-called "sacro-iliac dislocation."

There is a condition which we have termed "separation," found commonly in women who have had repeated pregnancies. It is a known fact that physiologically the sacro-iliac synchondrosis and the pubic synchondrosis separate during pregnancy. Occasionally, this separation will persist. It is a lateral separation and not a true dislocation. This "separation" is sometimes found in the young female who is poorly nourished, where there is physiologically a separation beyond the average normal. This we do not classify as "sacro-iliac dislocation."

(4) In dealing with chronic disease in the vertebræ, we are concerned, when interested in industrial accident work, with the end-result of disease, mostly because we do not commonly come in contact with active disease, such as tuberculosis or newgrowth. As a rule, we do not see cases of acute or active disease, such as tuberculosis or newgrowth, although occasionally cases are examined with an injury where there has been active tuberculosis or a beginning newgrowth.

The one serious disease which we are concerned with is the various forms of arthritis. Unfortunately, the nomenclature referable to arthritis is very much involved and in some instances meaningless and useless for our purposes. The terms arthritis deformans, spondylitis, hypertrophic and atrophic arthritis, rheumatoid arthritis and the Marie Strumpell type of arthritis, are all used very loosely to designate one and the same condition, excepting the Marie Strumpell type. We personally dislike to use the word "arthritis," because the word does not apply itself easily to the vertebræ as it does to the joint involvement. The etiological factors to date are so obscure and controversial and the changes which appear as the end-result are so much within the normal limits that we would like to speak of these changes as "hypertrophic changes" and eliminate the word "arthritis." It is in keeping with what has already been stated in regard to hypertrophic changes, especially in individuals over forty years of age.

In so far as industrial accident work is concerned, the etiological factors are not appliable unless they can be proven to be of recent traumatic origin. The unfortunate feature of these hypertrophic changes, as has already been stated, is the fact that they present a picture within the normal limits and apparently add a serious difficulty to X-ray interpretation.

There is a localized hypertrophic change, sometimes found to a moderate degree and

other times to a very extensive degree, which may be confined to two bodies, associated with an alleged injury that has occurred some time in the past within the compensation period. It is with the utmost

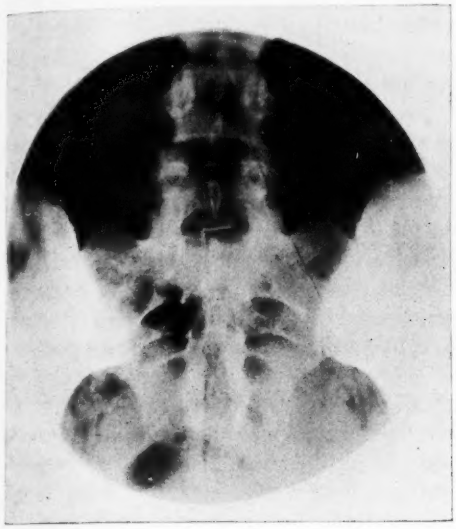

Fig. 17.—Separation of the synchondrosis bilateral in a young woman. Note how little articulation there is between the sacrum and the ilium.

difficulty that one can determine whether these changes are actually due to injury or to a local condition, such as postural or occupational changes, or a remote infectious process.

It is true following an acute osteomyelitis of the vertebræ, which is not a very common condition, that destruction occurs early wherever the focus may be and when regeneration takes place there is extensive bone proliferation. These proliferative bone changes may simulate to some extent the ordinary chronic hypertrophic changes. It is difficult to differentiate between these two conditions unless one is familiar with the past history, although the amount of bone proliferation in the osteomyelitic case is usually greater than is found in the purely arthritic case.

There is one observation that we have noted in an effort to differentiate between true arthritis, assuming it is of infectious origin, and the chronic hypertrophic chronological changes. In the type of infectious arthritis the proliferative bone changes occur, as a rule, on the lateral margin of the vertebræ. In cases with hypertrophic

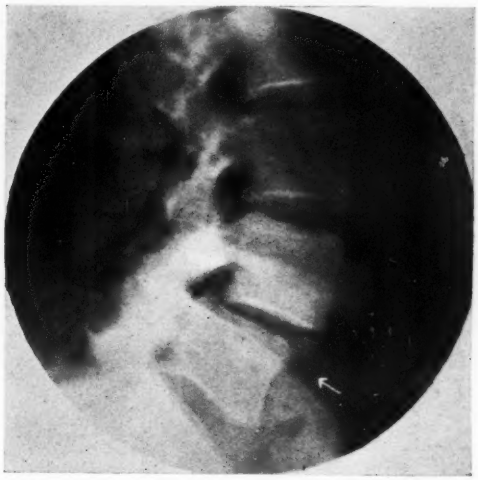

Fig. 18.—A forward dislocation of the lumbar vertebræ on the fourth, not due to trauma unless of early life. No history throughout the period of the individual's life of injury; man over fifty years of age. Only occasional symptoms from this condition.

changes, as brought out in this paper under the heading of chronological, occupational or postural changes, the changes appear on the vertebral or anterior margins of the vertebræ. It may not be of scientific importance to make this differentiation, and possibly it will not be entirely substantiated by the pathologist, but it is at least interesting to note that this differentiation can be made rather frequently. It is only mentioned as one possible means of differentiation.

Again referring to the localized hypertrophic changes between two bodies, so far as the writers are concerned, we have no definite proof that these typical localized changes are the result of immediate injury. Unless we find morphological changes of the body or parts of the body which indicate a tearing, fracture of a portion of the body or parts of the vertebræ, we do not consider these changes the immediate result of injury.

We cannot overemphasize the importance of a very careful consideration of the period of time that must elapse before these changes will appear and reach the stage in which we usually find them. If a little consideration is given to this feature of the problem, in a large percentage of cases this localized change will not be identified as the result of an alleged injury within the compensation period.

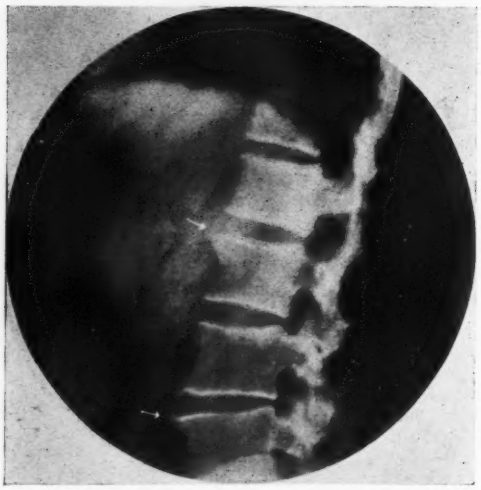

Fig. 19.—Hypertrophic changes due to age and not injury. It will be noted that these changes are on the anterior aspect of the bodies.

The end-result of chronic disease, such as tuberculosis, may give rise to a very confusing picture. It has already been stated that no matter how severe the injury, such as fracture or dislocation of the vertebræ, one never finds complete obliteration of the intervertebral space in one or the other diameter. We occasionally find a type of case in which two bodies are completely fused together. This may occur anywhere from the atlas or upper cervical region to the fifth lumbar vertebra. With this fusion we never find, or perhaps we should say very rarely, bone formation, or, in fact, any bony changes whatsoever at the point of fusion. This type of case has been diagnosed as a compression fracture. We have found that these changes are the result of a previous infectious process of a good many years' standing and represent the end-result of healing, the probable etiological factor in this type of case being tuberculosis.

We believe we have proof of this from at least one case in our series. We had the privilege of examining a case of active tuberculosis in the lower dorsal and upper lumbar vertebræ. We followed it during the progress of the disease for fourteen years, through the period of convalescence and finally complete healing. The end-result shows the two bodies completely fused without any line of separation. There are no signs of bone formation or regeneration, which naturally follows a fracture, and the two bodies appear as one unit.

It was also our privilege to study one other case of active tuberculosis. We made repeated examinations and a clinical cure was finally obtained. Later, at autopsy, the bodies were examined, and it was found that at least two were completely fused as one solid vertebra without evidence of new bone formation at the point of fusion.

With a recent accident there should be no confusion that such changes can occur in a few weeks, or even months. We are definitely of the opinion that we have sufficient proof to emphasize the importance of this observation that obliteration of the intervertebral space never occurs as the result of injury. It will appear occasionally in some of the rare congenital anomalies of the vertebræ, which should be differentiated from the result of disease.

It is infrequent that we are asked to examine a case of alleged injury in which we find bone tumor. Once in a great while a tumor of the osteochondroma type may be met with, occasionally sarcoma, but very rarely a benign bone cyst.

There is a type of case which one occasionally meets. Perhaps it does not necessarily come under the type of case which we examine in industrial accident work, yet it is worthy of mention. It is a condition of the vertebræ, either localized or general, including the pelvic bones, but not of

the femora, which simulates Paget's Disease, and which we have come to call a "localized Paget's Disease" of one body, or of several and of the pelvic bones. It has been found in some cases of this type that these are not changes due to Paget's, but to the rare forms of carcinoma which follow carcinoma of the prostate. If these cases are watched over a period of time, some of them may eventually show the characteristic appearance of carcinoma.

One cannot very well discuss the changes in the vertebræ referable to industrial accident work without mentioning syphilis. The changes due to syphilis are not commonly found in the spine, although occasionally one meets with a typical Charcot picture in the vertebræ, similar to the changes found in the joints of the long bones. The importance in recognizing this condition is in differentiating it from changes due to injury. Here again, one will usually find that the time between the alleged injury and the X-ray examination is not sufficient to allow the extensive bone changes seen in the X-ray film.

In conclusion, may we be privileged to state that we have attempted in this brief summary of injury and disease of the vertebræ to present these conditions as they appear in industrial accident work? We have tried to emphasize the fact that there is a normal standard vertebra, the normal limits, however, being somewhat variable and influenced by age, sex and occupation. We have attempted to enumerate some of these normal variations, particularly those due to age and occupation. Secondly, we have considered the abnormal variations, consisting of congenital deformities, deformities due to trauma and deformities due to disease. Particular attention has been paid to a differential diagnosis between changes due to trauma and those due to disease.

Under the topic of disease, we have discussed the so-called arthritic changes.

We appreciate full well, in the analysis of the X-ray evidence of variations in the appearance of the spine, that this paper is very rudimentary. Many of the questions discussed we have not been able to answer conclusively, but our purpose has been accomplished if we can sufficiently arouse interest among the profession at large to continue a standardized study of the classification of vertebral disorders. We shall rest content if, to any extent, this paper will be productive of a common terminology and a common viewpoint of the intricate changes which the X-ray reveals in the vertebræ.

THE DISTRIBUTION OF ENERGY IN THE CONTINUOUS X-RAY SPECTRUM*

By DAVID L. WEBSTER, PH.D.

Professor of Physics, Stanford University, California

IONIZATION SPECTRA

WHEN a beam of X-rays is analyzed by a crystal, the result, familiar to us all nowadays, is a spectrum of a type more or less like those in Fig. 1.

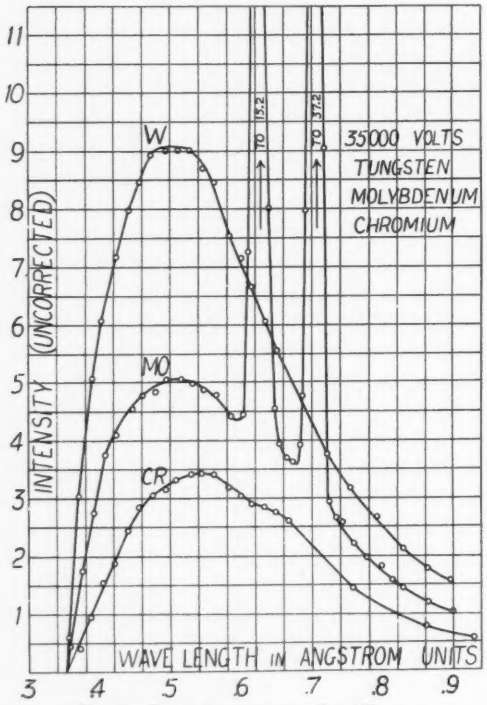

Fig. 1. Ionization spectra, after Ulrey.

This figure, taken from a paper by Ulrey[1] in 1918, shows the spectra of three elements, plotted in the usual way, with the abscissæ representing wave lengths and the ordinates the measured intensities. One of the spectra shows characteristic lines, and all show the continuous spectrum, which begins at the short-wave limit given by the quantum law and continues indefinitely into the longer wave lengths. This continuous spectrum always contains a large part of the energy, if not practically all, and it is therefore a problem of great importance to find out how the energy is distributed among the different wave lengths.

This problem is important for two reasons: first, in finding evidence on the mechanism within the atom, that emits these rays; and second, for the practical purpose of furnishing more exact data for the theory of radiotherapy.

At first sight, one might expect to be able to read off the energy at different wave lengths directly from such curves as these. Unfortunately, however, these curves, and in fact almost all spectrum curves published thus far, do not represent energy, but only ionization as observed in a spectrom-

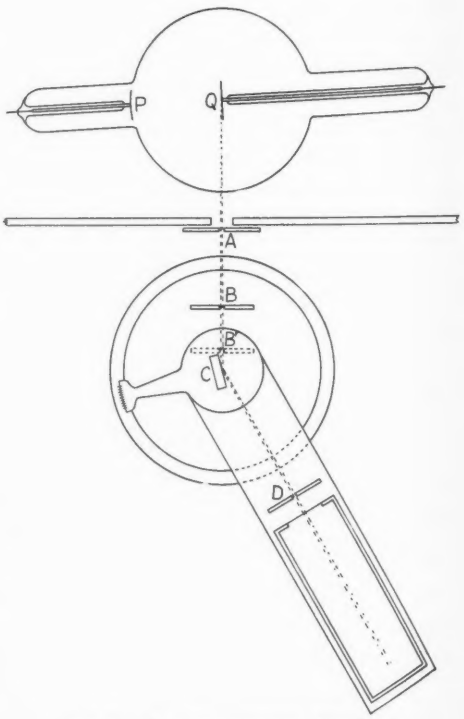

Fig. 2. X-ray spectrometer, after Bragg.

*Read before the Radiological Society of North America, San Francisco, June, 1923.

[1]C. T. Ulrey, Physical Review, *11*, 401, May, 1918.

eter. This is very different, for reasons that may be seen from Fig. 2, which is a diagram of the Bragg spectrometer, taken from Bragg's book, "X-Rays and Crystal Structure."

To plot a spectrum, such as those of Fig. 1, the experimenter must run the X-ray tube at a constant voltage and current, and then turn the crystal and ionization chamber to get one wave length after another, measuring the ionization at each point. In such measurements there are many factors that change beside the actual energy of the rays to be selected. The efficiency of reflection of the crystal, for example, varies continuously from one wave length to another, and so does the sensitivity of the ionization chamber, as well as several other factors, all of which conspire to distort the curve that is obtained. To interpret such a curve in terms of true energy, therefore, one must evaluate all these variable factors at each point, and correct for them. This is a very difficult piece of work, but it has been attempted, with a fair degree of success, by Dauvillier,[2] and later by Wagner and Kulenkampff.[3]

This work is so difficult, however, and the results are so liable to error, that it seems highly desirable to find some other method of eliminating these corrections, if possible. Fortunately, we can eliminate most of them fairly simply.

The method for doing this depends on the fact that we are interested not only in the distribution of energy in the spectrum at some one voltage, such as the 35 kv of the spectra of Fig. 1, but also in how this distribution changes from one voltage to another, as illustrated qualitatively in Fig. 3.

This figure shows the tungsten spectrum, as plotted by Ulrey[4] without corrections, and it is evident here that the intensity must be considered mathematically as a function of two variables, the voltage, V, and the wave length, λ.

To specify intensity exactly, of course, we cannot speak rigorously of the energy actually at a given wave length, λ, because

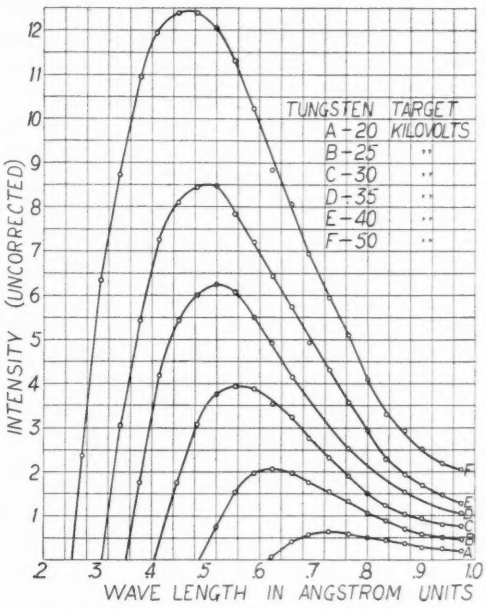

Fig. 3. Ionization spectra of tungsten, after Ulrey.

this would be infinitesimal. What we must speak of is rather the energy in a short range of wave lengths, to be specified mathematically in terms of a function, $J(V, \lambda)$, such that $J(V, \lambda)d\lambda$ is the energy at voltage V, in a short interval $d\lambda$, at the wave length λ. We may think of this function $J(V, \lambda)$ as one whose graphs against λ are spectrum graphs much like those of Figs. 1 and 3, or more exactly as those would be when corrected to represent true energy. This function we may call the energy distribution function, and our fundamental problem is to determine its mathematical form and then plot the corrected spectrum graphs.

DETERMINATION OF $J(V, \lambda)$

However, since $J(V, \lambda)$ is a function of V as well as of λ, an alternative way to represent it is to plot another series of graphs, in each one of which λ is kept constant and

[2] A. Dauvillier, Thesis, Université de Paris.
[3] E. Wagner and H. Kulenkampff, Phys. Zeitschr., *23*, 503, Nov.-Dec., 1922.
[4] C. T. Ulrey, *loc. cit.*

$J(V, \lambda)$ is plotted against V. Experimentally this means to set the spectrometer for a certain wave length, λ, and hold it there while we change the voltage, V, on the tube, and thus measure $J(V, \lambda)$ for the one value of λ at various V's. A graph obtained in this way is called an "isochromat," and a set of isochromats for all different wave lengths represents all the facts as completely as a set of spectra.

Comparing the two types of graphs, the isochromats have a distinct advantage. For while many factors, such as crystal reflection efficiency, vary from point to point in each spectrum graph, these factors are almost all constant in each isochromat, and vary only from one isochromat to the next. The only important factor that does not follow this rule is the absorption of the X-rays in getting out of the target itself, but this factor is even more variable in a spectrum graph. We may express these facts in mathematical form, in the equation $J(V, \lambda)=f(\lambda)F(V, \lambda)$ where $F(V, \lambda)$ is a factor that can be determined completely from a set of isochromats, corrected for target absorption; and all the other correction factors, that are so troublesome in the analysis of spectrum graphs, go into the factor $f(\lambda)$. The improvement made by this alignment of the data is, that it is obviously likely to be easier to determine a function of one variable than one of two, and it turns out to be possible to determine $f(\lambda)$ without a detailed study of these correction factors.

To do this, however, we need more data, and we have available one more type of measurements, namely, those of the total X-ray energy, irrespective of wave length. The total energy is, of course, a function of one variable, V, only, and therefore can be represented $E(V)$. More specifically, since the best measurements available, chiefly those of Beatty, show that it varies as V^2, we can say $E(V)=AV^2$.

Now the total energy is related to the spectrum in being the sum of the energies at all wave lengths, or since the spectrum is continuous,

$$E(V)=\int_{\lambda_0}^{\infty} J(V, \lambda)d\lambda,$$

where we are summing up the spectral energy from the short-wave limit λ_0 to infinity. Substituting for E and J the values just obtained for them, we get

$$AV^2=\int_{\lambda_0}^{\infty} f(\lambda)F(V, \lambda)d\lambda$$

in which the function $f(\lambda)$ is the only unknown. We have now only to put in the experimentally determined function $F(V, \lambda)$, and solve for $f(\lambda)$.

For this purpose, we may use some data taken by Webster and Hennings[5] and shown in Fig. 4. These are a set of isochromats of

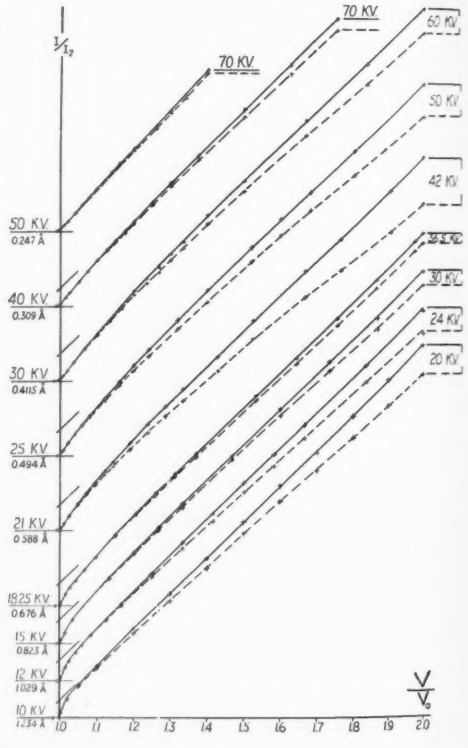

Fig. 4. Isochromats of molybdenum, after Webster and Hennings. Dotted lines, uncorrected graphs; full lines, corrected for target absorption.

[5] D. L. Webster and A. E. Hennings, Phys. Rev., *21*, 312, March, 1923.

molybdenum. The lowest one, for example, is an isochromat for $\lambda=1.234$Å. It starts at 10 kv, the quantum voltage for this wave length, and is continued here up to 20 kv. The next one above it is for $\lambda=1.029$Å. It starts at 12 kv, but here the voltage and intensity scales are so reduced as to bring it down to the same size as the first one. The others are treated likewise, and the result is seen to be a set of graphs all very much alike. This point is important, because it enables us to simplify the experimental function $F(V, \lambda)$ still further. Practically, the reduction of voltage scales amounted simply to plotting the data, not against the voltage itself, but against the ratio V/V_0, where V_0 is the quantum voltage for the particular wave length in question. Thus if we let $U=V/V_0$, then $F(V, \lambda)$ can be expressed approximately as a function, $G(U)$, depending only on the single variable U.

Now to perform the integration that was required, so as to solve for $f(\lambda)$, we can assume as a trial value,

$$f(\lambda)=\frac{K}{\lambda^n},$$

where K and n are constants. This puts the integral equation given above into the form,

$$AV^2=\int_{\lambda_0}^{\infty}\frac{K}{\lambda^n}G(U)\,d\lambda.$$

The short-wave limit, λ_0, occurring in this equation is, of course, the short-wave limit for the voltage V, while the quantum voltage, V_0, is the voltage which first produces rays at the wave length λ. λ_0 is therefore determined by V, and V_0 by λ, both according to Einstein's photoelectric equation, which may be expressed either as

$$\lambda_0=\frac{\gamma}{V} \text{ or } V_0=\frac{\gamma}{\lambda}$$

where $\gamma=12.345$ kilovolt-Ångstroms. The ratio U is therefore expressible in several forms,

$$U=\frac{V}{V_0}=\frac{V\lambda}{\gamma}=\frac{\lambda}{\lambda_0}$$

Replacing λ by $U\lambda_0$, the equation becomes

$$AV^2=\frac{K}{\lambda_0^{n-1}}\int_1^{\infty}\frac{1}{U^n}G(U)\,dU,$$

and the integral is no longer dependent on V, but is a constant. Then replacing λ_0 by γ/V, we have

$$AV^2=\text{constant}\times V^{n-1}$$

or

$$n=3,$$

and

$$J(V, \lambda)=\frac{K}{\lambda^3}G\left(\frac{V\lambda}{\gamma}\right).$$

This, as noted above, is an approximation only, but a good one, and the same general methods can be used even with $G(U)$ different in different isochromats, but with more complexity in the integration. We have now only to determine $G(U)$ from the isochromats and plot $J(V, \lambda)$.

As a first approximation, $G(U)$ is nearly linear, starting from $U=1$, or $G(U)=(U-1)$.

The deviations from linearity are of a form suggesting the function $(1-e^{-x})$, so we shall assume as a second approximation,

$$G(U)=[(U-1)+p(1-e^{-q(U-1)})].$$

The variations in the form of $G(U)$ for the different isochromats can be expressed mathematically by making p and q functions of λ (or of V_0), but for the present discussion we shall neglect these variations (since the non-linear term is always small) and plot $J(V, \lambda)$ with values of p and q taken from a typical isochromat, that for which $V_0=30$ kv, or $\lambda=0.412$Å. The result is the full-line curve in the right-hand diagram of Fig. 5.

For many purposes it is more convenient to express the energy distribution, not on a wave-length scale, as given by the function $J(V, \lambda)$, but on a scale of frequency of vibration, ν. Such a scale is not only a more direct theoretical approach to the problem of the mechanism of electronic vibrations, but also, since frequency is inversely proportional to wave length, it expands the short-wave end of the spectrum,

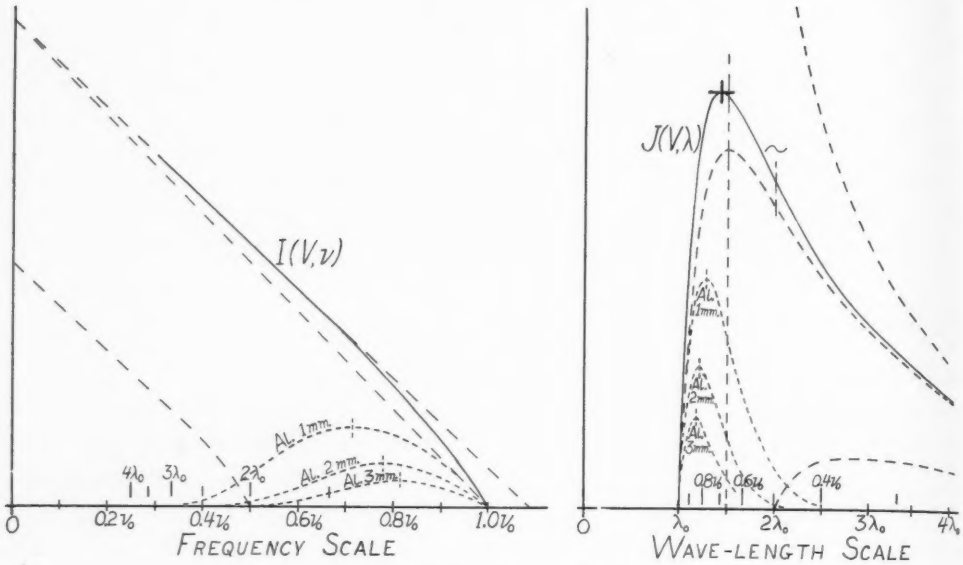

Fig. 5. Typical energy spectrum of molybdenum (omitting characteristic rays).

in which we are most interested for practical purposes.

Because of this change, a given interval, $d\lambda$, at one part of the wave-length scale, does not mean the same frequency interval as an equal $d\lambda$ at another part. Therefore, in setting up a distribution function for the frequency scale, if we let

$$I(V, \nu)d\nu = J(V, \lambda)d\lambda$$

we cannot get I by simply expressing J with λ replaced by its equivalent c/ν (where c is the velocity of light). We must also replace $d\lambda$ by its equivalent, $(c/\nu^2)d\nu$, and U may be expressed as ν_0/ν, where ν_0 is the high frequency limit, corresponding to λ_0. Making these substitutions,

$$I(V,\nu) = \text{constant} \times \{(\nu_0 - \nu) + \nu p(1 - e^{-q\left(\frac{\nu_0}{\nu} - 1\right)})\}$$

Since the first term, the linear one, is the larger of the two in this expression, this means that $I(V, \nu)$ is almost linear except near the high frequency limit, as shown in the left-hand diagram of Fig. 5.

The difference between this graph and that of $J(V, \lambda)$ is, as one might expect, that at the high frequencies, or short wave lengths, where the frequency scale is expanded relatively to the wave-length scale, the frequency graph is lower, whereas at the low frequencies, or long wave lengths, their relations are reversed. In this particular figure the scales of frequency and wave length happen to be such as to make corresponding intervals geometrically equal at the point, $\lambda = \sqrt{5}\,\lambda_0$, or $\nu = \sqrt{\frac{1}{5}}\,\nu_0$, but any other scales would of course be equally allowable. The scales of ordinates are then chosen so as to make I and J also geometrically equal at this point, and thereby make equal areas anywhere under the two graphs represent equal quantities of energy. Thus, for example, the area under the J graph between λ_0 and $2\lambda_0$ represents the total energy in that part of the spectrum, and it is exactly equal to the area under the I graph between the corresponding points, ν_0 and

$0.5\nu_0$. This rule holds for any such corresponding intervals.

CONCLUSIONS AND PRACTICAL APPLICATIONS

Now let us draw some conclusions from these results.

First, comparing Fig. 5 with Figs. 1 and 3, it is obvious that there is much more energy in the longer wave lengths than one would expect from the ionization spectra.

Second, the effect of reducing the voltage to half value, which must, according to the V^2 law, quarter the total energy, receives a very simple interpretation in the I graph, whose dimensions in both directions are halved, as shown by one of the broken-line graphs of Fig. 5.

Third, on the spectra of filtered rays, we may see what changes are made by filtering, as shown in the graphs marked Al 1mm, Al 2mm, and Al 3mm, which were plotted by calculating the intensities left after such filtering, using the absorption coefficient data of Richtmyer.[6] These absorbed spectra, of course, retain some of the excess in the long wave lengths, relative to corresponding ionization spectra, and show that filtered rays are even less homogeneous than one might expect.

Fourth, the linear first approximation for $G(U)$, as $(U-1)$, would give a corresponding linear first approximation for $I(V, \nu)$, as constant $\times(\nu_0-\nu)$, as shown by the straight broken-line graph just under the true I graph. The corresponding first approximation for J is shown similarly. It has a maximum at exactly $1.5\lambda_0$ and a point of inflection at $2\lambda_0$, and at long wave lengths it would approach assymptotically the graph of $(\lambda_0/\lambda)^2$, shown above that of J.

Fifth, the departure from the straight graph, represented by the non-linear terms in $G(U)$ and $I(V, \nu)$, comes experimentally from the corresponding departure of the isochromats from straight lines, and it results in an increased percentage of the energy in the higher frequencies, or a shift of the maximum of $J(V, \lambda)$ to the short-wave side of $1.5\lambda_0$. As this is a result very desirable for radiotherapeutic work, where high-frequency rays are wanted and low-frequency ones are filtered out as much as possible, it is important to see what conditions favor it the most.

One such condition is the use of rays leaving the target at as small an angle as is practicable with the direction of the cathode rays, this angle in the present case being 110°. There are several lines of experimental evidence pointing to this conclusion, starting with some work by Kaye,[7] before the invention of the spectrometer, and best shown in some work by Wagner,[8] on ionization spectra, in 1920. On the theoretical side, I believe this is best interpreted as a result of the Doppler effect, from the motion of the cathode rays emitting the X-rays, but more work should be done before definite statements can be made on that point, which is of obvious theoretical importance.

Another factor that influences the non-linear term in $I(V, \nu)$ is the metal used for the target. The heavier metals are well known to be the stronger emitters, with total energy approximately proportional to atomic weight (or more probably atomic number, if the law is exact at all); but in addition to this, the heavy metals show a larger non-linear term, and therefore larger percentage of hard rays, than the light ones. This fact appeared first in some isochromats plotted by Webster and Clark,[9] with platinum up to 20 kv, as compared to earlier ones for rhodium,[10] which were very much like the present ones for molybdenum. Likewise Ulrey's ionization spectra, reproduced here in Fig. 1, show the effect in the relative positions of their maxima. I have checked it also, very roughly, up to 70 kv with copper and tungsten. The best evidence for it, however, is a set of spectra on the frequency scale, at 11.7 kv, obtained recently by Wagner and Kulenkampff, by correction of ionization spectra, and reproduced here as Fig. 6, and one

[6] F. K. Richtmyer, Phys. Rev., *18*, 13, July, 1921.

[7] G. W. C. Kaye, Proc. Camb. Phil. Soc., *15*, 269, 1909.

[8] E. Wagner, Phys. Zeitchr., *21*, 621, Nov., 1920.

[9] D. L. Webster and H. Clark, Proc. Nat. Acad., *3*, 181, March, 1917.

[10] D. L. Webster, Phys. Rev., *7*, 599, June, 1916.

spectrum of tungsten, at 65.6 kv, published by Dauvillier,[11] which is very much like the graph of $J(V, \lambda)$ in Fig. 5, but with the maximum at 1.2Å instead of 1.43.

With decreasing wave length, according to Fig. 4, as well as in the very rough work

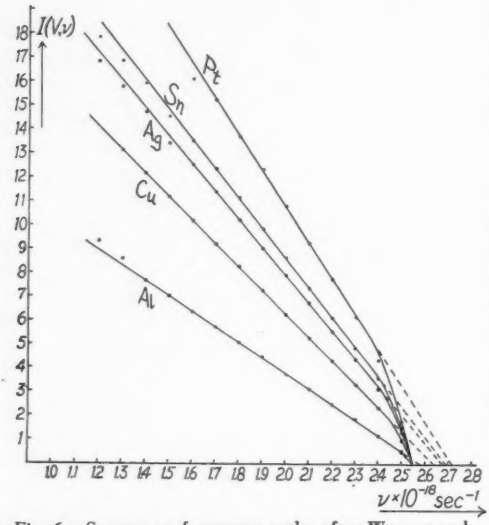

Fig. 6. Spectra on frequency scale, after Wagner and Kulenkampff. Voltage 11.7 kv.

on copper and tungsten, the non-linear term seems to diminish somewhat, and it may possibly disappear entirely at the very short wave lengths used in radiotherapy; but Dauvillier's work indicates that it is still strong in tungsten down to 0.2Å or less. If it does not disappear, we may predict that for a given current in the tube, a thorium target will show a distinct advantage over the tungsten targets now used, not only in the total quantity of X-ray energy emitted, but also in its distribution in the spectrum.

In this connection it is of interest to note that thorium has better characteristic rays, also. For the K^{α} lines of tungsten, according to Duane, Patterson and Stenstrom,[12] are at 0.20860 and 0.21341 Å, or say 0.210 Å for their center of gravity, while those of thorium, calculated from Kossel's frequency law as applied to their data on the K and L absorption limits, are at 1.33 and 1.38 Å, with a center of gravity at about 0.135 Å. Therefore, a half-millimeter copper filter, according to Richtmyer's[13] absorption data, should transmit 46 per cent of the energy of the tungsten K^{α} lines and 77 per cent of the thorium K^{α}, while the corresponding figures for a whole millimeter are 21 per cent and 59 per cent, giving the thorium rays a marked superiority in quality.

Since the characteristic rays of any K series are excited first at the quantum voltage for the limit of the series,[14] we may predict the K excitation voltage of tungsten as 69.3 kv, and that of thorium as 109 kv. At voltages between these, and for a moderate interval above the latter, the lower excitation voltage of tungsten necessarily gives it the advantage in intensity. Higher up, however, although no definite data are available on this point, so far as I know, it seems reasonable to suppose that the thorium lines should become at least of the same order of intensity, if not stronger. The superiority of thorium characteristic rays in intensity is thus not so certain as that in quality, at least before filtering, but the greater penetration in copper is almost sure to result in greater intensity after filtering, at least if the voltage is high enough. As Nicholas and Rehfisch[15] have found the characteristic lines very prominent even in tungsten spectra, at 150 to 200 kv, and even after filtering through a whole millimeter of copper, any advantage to be gained in improved characteristic rays is important.

It is therefore fortunate that we can sum up these comparisons of tungsten and thorium with a definite statement, that for both the continuous and characteristic rays, there is very good reason to expect thorium to be definitely superior, provided only that a thorium tube can be developed with water

[11] A. Dauvillier, *loc. cit.*
[12] See W. Duane, Bull. N. R. C., 1, No. 6, 1920.
[13] F. K. Richtmyer, *loc. cit.*
[14] D. L. Webster, *loc. cit.*
[15] Not yet published.

cooling efficient enough to enable it to carry the same current.

SUMMARY

To sum up our conclusions, one of the most important is that we can now make reasonably approximate calculations of the distribution of energy in any given X-ray beam. The theoretically important case of rays subject to no absorption is illustrated in the full-line graphs of Figs. 5 and 6; and the practical cases of rays filtered through glass, aluminum or copper may be handled by starting with the spectra of unabsorbed rays and multiplying each ordinate by the transmission ratio appropriate to its wave length, as calculated from absorption coefficients such as Richtmyer's, and as illustrated in Fig. 5. The spectra yet available are very limited as to materials, voltages and directions, but it is to be hoped that these limitations will soon be removed and that data will be available for all important cases.

Meanwhile, the conclusion of the most immediate practical importance is probably that relating to the advantage of thorium over tungsten for deep radiotherapy, provided thorium can be as efficiently water-cooled.

RENAL FLUOROSCOPY AT THE OPERATING TABLE[1]

By WILLIAM F. BRAASCH, M.D., and RUSSELL D. CARMAN, M.D.

Sections on Urology and Roentgenology, Mayo Clinic, Rochester, Minnesota

A PRELIMINARY report was published in December, 1919,[2] on the use of renal fluoroscopy at the operating table. Since then the method has been used routinely in the Mayo Clinic in most operations for renal lithiasis other than nephrectomy. The various advantages and disadvantages of renal fluoroscopy were observed in a series of 161 operations and are briefly described. In general it may be said that the advantages previously reported have been fully corroborated. The procedure is of greatest aid (1) in determining the presence of renal stone in cases in which roentgenograms, cystoscopy and urography fail to identify a doubtful shadow; (2) in the exact localization of the stone in the kidney, and (3) in insuring the removal of all stones, particularly if the shadows in the roentgenogram are multiple.

With regard to the identification of doubtful shadows it must be said that, since the development of urography, but few shadows in the renal roentgenogram remain unidentified. Nevertheless, when the occasion arises, renal fluoroscopy offers a rapid method of identification, and one which eliminates the not inconsiderable damage to the kidney by the usual methods of exploration. Ordinarily, if the stone cannot be felt through the cortex, the pelvis is opened and the finger introduced into the pelvis and calyces. When the stone is of considerable size and free in a normal or only slightly dilated pelvis, there is, as a rule, not much difficulty in locating it, yet it is surprising how easily a stone may elude the palpating finger even in a normal pelvis. When the pelvis and calyces are dilated it may be almost impossible to find a small stone. If the pelvis is unusually small and the stone is situated in the end of a calyx, it may be inaccessible to the finger or sound.

In a recent survey of patients operated on at the Mayo Clinic for removal of renal stone, twenty-eight had been operated on elsewhere for stone without it being found. When the surgeon fails to find the stone by palpation, he resorts to needling and deep incisions into the cortex. Needless to say, such procedures cause considerable damage to the cortex, and when the incisions are extensive, renal function may be greatly reduced. When the usual methods of renal palpation, either external or with the finger in the renal pelvis, fail to localize the stone, fluoroscopy will obviate unnecessary surgery.

The difficulty of exact interpretation of shadows in the renal roentgenogram with regard to the number of stones present is not generally realized. Interpretation may be very inexact. In a recent review of 1,061 patients operated on at the Mayo Clinic for renal lithiasis, it was noted that (1) a single shadow was seen in the roentgenogram and multiple stones were found at operation in 146 cases; (2) multiple shadows were seen in the roentgenogram and a single stone was found at operation in sixty-six cases; (3) no shadows were seen in the roentgenogram, and one or more stones were found at operation in twenty-one cases, and (4) shadows were reported indicating stones in the upper ureter, but the stones were found in the kidney, not in the ureter, in five cases. From this it is evident that the roentgenogram cannot be relied on too much for the number of stones which may be in the kidney. It is self-evident that if the roentgenogram shows but one stone shadow, the surgeon will not spend a great deal of time, or damage the kidney in searching for more. It is equally true that with multiple shadows in the roentgenogram, much unnecessary destruction of renal tissue may result from the search for other stones when only one is present.

[1]Read before the Radiological Society of North America, Rochester, Minnesota, December 3-7, 1923.

[2]Braasch, W. F., and Carman, R. D.: Renal fluoroscopy at the operating table. Jour. Am. Med. Assn., 1919, LXXIII, 1751-1752.

In a surprisingly large number of cases a single shadow was seen in the roentgenogram and multiple stones were found at operation. Misinterpretation is largely explained by the fact that the stones were so situated that the shadows overlapped, giving the appearance of a single stone. In the case of irregularly shaped shadows the difficulty of determining whether two stones are partially overlapping or whether a single branched stone is present, is self-evident. Frequently a second stone will be so situated as to give the appearance of an irregular stone, when in reality there are two stones situated in different planes.

In the case of multiple shadows there may be a definite shadow in the roentgenogram with one or more indefinite shadows, and it may be impossible to determine whether the latter are caused by stones or by some extra-renal factor. When multiple shadows are reported and only a single stone is found, the error is sometimes explained by irregularity in the shadow suggestive of multiple stones, the stones being branched, dumb-bell, or jackstone-shaped.

In the removal of irregularly shaped stones a fragment may easily be broken off without the surgeon's knowledge. Since this occurs often in cases of branched stone impacted in the end of a minor calyx, it may be impossible to palpate the fragment. This may also occur with pockets of sandy material incompletely removed by curette or irrigation. Multiple small renal stones scattered in various portions of the kidney are often difficult to find at operation, and their complete removal necessitates thorough exploration of the kidney with resulting extensive destruction of tissue. Their exact localization and complete elimination can usually be accomplished with minimal renal damage with the aid of the renal fluoroscope.

ILLUSTRATIVE CASES

Case 1. The patient gave a history suggestive of renal lithiasis. The renal roentgenogram revealed three or possibly four small shadows scattered through the renal area, none of which was more than 5 mm. in diameter. At operation it was only after a search that two small stones were found in the calyces. Fluoroscopy then revealed but one stone remaining, which the surgeon's finger, guided by the fluoroscope, was able to find. The other shadow was proved to be of extra-renal origin.

Case 2. A patient whose roentgenograms had demonstrated multiple stones in the kidney, and whose cystoscopic examination had indicated a fair degree of function remaining in the kidney, was referred for nephrolithotomy. Although evidence of considerable involvement of renal tissue was found at operation, an attempt was made to save the kidney. Under the guidance of renal fluoroscopy, six stones of variable size were found and removed. After the sixth fragment had been removed, fluoroscopy demonstrated two small shadows remaining in the renal substance. Since the surgeon was unable to find these fragments, even with the aid of the fluoroscope, and since the kidney was largely destroyed, further search was considered inadvisable, and the kidney was removed. On sectioning the kidney, no evidence of the stones could be found, yet when the dissected kidney was viewed with the fluoroscope, two quite definite shadows could be seen in the renal substance. They were then localized by means of pins, and on dissecting out the minor calyces, with the pins as a guide, two small flat stones were found incarcerated in the ends, which had eluded both surgeon and pathologist.

From this it is evident that the number of patients with stones remaining in the kidney after operation will be greatly reduced if renal fluoroscopy is used. Any stone subsequently occurring in the kidney may then be regarded as a true recurrence. Renal fluoroscopy has given additional impetus to the recent tendency toward conservative surgery in cases of renal stone. Formerly, if the various fragments of multiple or branched stones were not all readily found and removed, the surgeon often considered it wiser to remove the kidney than to risk leaving one or more stones. Under the guidance of fluoroscopy, the surgeon is not only helped in finding the stones, but is assured that they are all removed.

TECHNICAL DIFFICULTIES

Fluoroscopy of a kidney which cannot be completely delivered because of a short pedicle, or as the result of being fixed by adhesions due to a previous operation, or

because of anomaly, anatomic deformity, and so forth, may be unsatisfactory, but this did not occur in more than 10 per cent of the cases observed. Even in cases in which the kidney was only partially delivered, and the patient was not too large, accurate renal fluoroscopy was usually feasible.

It has been asserted that small fragments of stone may be easily overlooked by the fluoroscope. Minute shadows, with a diameter of 1 or 2 mm., sometimes observed in a post-operative roentgenogram in cases in which the kidney, with the aid of the fluoroscope, has been pronounced negative, are the only evidence of such a possibility. It may be impossible to determine whether these shadows are intra-renal without subsequent clinical observation. Patients are not infrequently observed who pass small fragments of stone shortly after nephrolithotomy, even when both operative fluoroscopy and post-operative roentgenograms are negative. In fact, minute fragments probably are often scaled off in the removal of stones; thus slight deposits of sand-like material are left in the kidney, which are of no surgical importance. The attempted surgical removal of such minute fragments, even under the guidance of fluoroscopy, would hardly be justified, since they are usually passed spontaneously.

The percentage of error in renal fluoroscopy with regard to failure to find stones of appreciable, and possibly of surgical size is, with proper technic, very small. Naturally, the skill of the roentgenologist and care in preliminary preparation are important factors. In the 161 conservative operations for stone in which renal fluoroscopy was used, the post-operative roentgenogram revealed definite fragments of stone remaining in the kidney in only two cases, an error of 1.2 per cent. There was also one case in which the kidney was not well elevated and fluoroscopy was unsatisfactory, and in which the post-operative roentgenogram revealed the possibility of two stones remaining. In contrast to this, among 520 conservative operations for renal stone without renal fluoroscopy, there were shadows of stones in the post-operative roentgenogram in 51 cases, approximately 10 per cent.

The technical details of renal fluoroscopy are of the greatest importance in insuring its success. The advantageous position of the kidney, the preparation of the roentgenologist's eyes, and the absolute darkening of the room, are the most essential details. The exaggerated lateral position with a latero-anterior incision offers the best exposure of the kidney. The kidney should be lifted as far above the level of the wound as possible, and the edges of the wound depressed. It is best suspended by narrow strips of gauze. While under inspection it should be slowly rotated so as to offer the fluoroscopist a view of shadows in different planes; the movement itself aids in detecting shadows. While it is desirable to bring the kidney above the level of the wound, it is not always essential, since fairly good inspection is possible with partial elevation. When the entire kidney cannot be brought up sufficiently, elevating either pole, especially the lower, will assist the fluoroscopist. An outline of the kidney may be surprisingly clear under such circumstances. Needless to say, all sponges, pads, clips and instruments should be removed from the line of vision. The preparation of the fluoroscopist's eyes by having them darkened for a period of fully thirty minutes before fluoroscopy is of paramount importance. Unless the pupils are completely dilated, the inspection will be faulty. It is of equal importance that the room be completely darkened at the time of observation. If the kidney is, for any reason, fixed, and if the abdominal wall is thick, successful fluoroscopy may not be possible.

Recently Quinby has suggested a method of insuring complete removal of stones from the kidney by means of roentgenograms of the kidney made at the operating table. Small protected films are placed in direct apposition to the exposed kidney, and the roentgenograms are then made. By means of a rapid developing process, it is

claimed that these films can be read three or four minutes after exposure. While a delay of this kind is not great, nevertheless technical errors could easily prolong it. Furthermore, as much effort and technical efficiency are required of the roentgenographer to insure a good film as are necessary with fluoroscopy.

The greatest advantage of fluoroscopy is that it permits of more exact localization of the stone than any other method. This is accomplished by ascertaining the relative position of the stone, and by inserting either the surgeon's finger or some metal instrument into the renal pelvis and calyces. Often in this manner only can the exact position and level of the elusive stone fragment be discovered. It must be admitted, however, that in cases in which the kidney cannot be elevated and the abdominal wall is too fat for fluoroscopic penetration, the renal film may be a valuable adjunct to fluoroscopy.

In conclusion it may be said that the value of renal fluoroscopy varies inversely with the skill of the surgeon. And yet, even among the most experienced surgeons it is often proved to be invaluable. In fact, it may be concluded that a conservative operation on the kidney for stone is not good surgery unless it is accomplished with the help of renal fluoroscopy.

DISCUSSION

DR. A. B. MOORE (Rochester): Dr. Braasch has covered the subject so thoroughly that there is not anything for me to say except to emphasize, possibly, a few of the minute details in the part of the operation which most concerns the roentgenologist. In the first place, we have found it absolutely essential to have a room that can be satisfactorily darkened. Therefore, in the new operating suite at St. Mary's we have a room equipped with curtains, motor controlled, which is absolutely satisfactory for all types of fluoroscopic work. Secondly, it is absolutely essential that the fluoroscopist's eyes be accommodated. It has been our custom to sit in a darkened room and then wear dark glasses until the surgeon is ready for our part of the examination. We prefer, when practical, to make a preliminary examination after the kidney has been delivered, before the kidney pelvis has been opened. In this way it assures us that our eyes are in the proper condition and it enables us to localize the shadows. Then after the surgeon has removed as many stones as he can find, we make our examination to tell him whether or not the kidney is free from stones. As Dr. Braasch has said, it is essential that one should have the full co-operation of the surgeon, that the kidney be well exposed and mobilized in a plane parallel with the long axis of the fluoroscopic bonnet. The roentgenologist is equipped with a sterile pointer, so that when he localizes the shadow, the surgeon by introducing a forceps into the kidney may be guided to the stone. We have been successful in assisting the surgeon to remove some very small fragments of stone and we feel personally that this feature in kidney operations is most valuable.

It has been asked quite often why the urologist or the surgeon does not do a fluoroscopic examination personally. I have always felt that it requires a more or less educated eye—educated to fluoroscopy. We are asked, secondly, as to the danger to the hands from burns. We use the fluoroscope with the lead protection around the handle and we feel that our hands are well protected. The surgeons, I think, are not particularly anxious to do the work on account of the possibility of burning their hands, nor is it practical for them to accommodate their eyes for fluoroscopy.

DR. L. T. LEWALD (New York): I have not had an opportunity to actually try out this procedure. I have watched it with great interest at this clinic. I wonder if any other place has equipped itself for actually doing that. I have seen what Dr. Braasch has stated, taking an X-ray after the removal of a stone from the kidney, and a few days or weeks after the operation finding a fragment of stone present. There

is no doubt about the absolute necessity of this procedure, if we are going to cut down the number of so-called recurrent stones in the kidney, some of which have as their basis stones or parts of stones left in the kidney at the time of the first operation.

DR. R. C. BEELER (Indianapolis): At the Methodist Hospital, in Indianapolis, we have used this method of renal fluoroscopy for Drs. Wishard, Hamer and Mertz. On the few occasions when we have used it we have found that we could aid them very much. The difficulty they have is to get every kidney delivered; if they do, we feel that we can find all the stones. We are not so sure in those cases where the pedicle is short and the kidney is not delivered. Dr. Braasch is to be congratulated upon this method.

DISCUSSION ON PAPER ENTITLED "ROENTGENOLOGIC DIAGNOSIS OF CHOLECYSTIC DISEASE," BY DR. R. D. CARMAN, DR. W. C. MACCARTY AND DR. JOHN D. CAMP, OF ROCHESTER[1]

DR. A. W. GEORGE (Boston): I thought when Dr. Camp started that I could follow him, and I did for a little way, but my head is in such a whirl with the figures and the vastness of the work that I cannot. I suppose next Friday night there will, all of a sudden, come to me certain questions I would like to ask and argue with him. It is a great deal like the presidential campaign at the present moment; there is a President, he is there and doing certain things, hopes he will continue to do so, and perhaps a little later he will be out and somebody else will be in. This work is a good deal like that to me, just at the present moment. It is a tremendously big problem, and if we, —I say we, Dr. Leonard and myself,— have seemed to be over-enthusiastic, perhaps a little too positive at times, it has been perhaps in an effort to stimulate others to help us; in other words, to help the whole problem. I do not know whether, right off hand, I can say that this work of Dr. Carman's is constructive or destructive; whether we have to begin and start all over again, or whether, when we see his figures on paper and can analyze them, they will be of distinct help to us. It is so vast, when you are talking of 2,500 cases—I would not dare to say how long it would take us to get 2,500 cases or how long it has taken him. How long has it taken?

DR. R. D. CARMAN (Rochester): About a year.

DR. GEORGE: Well, of course, we have seen about 2,500 cases in about the same time, including all kinds of gastro-intestinal cases. Every kind of gastro-intestinal case has just the same kind of X-ray examination for the gall bladder that the gall-bladder case has.

He has given us a great deal to think about. Whether you and I agree on the primary or indirect evidence or not makes very little difference, if, altogether, we are gradually getting facts that are worth something. We cannot go on with this work alone; we must have your help. We can do so in Boston, because a great majority of the men in Boston are satisfied with the work, or we would not be doing it every day and doing it in such large volume, but it is not helping the great mass of men if there is any great controversy about it.

I believe the Bucky diaphragm is the most important instrument that has been given to us among all that we have. I think we could do away with films and double screens, go back to the glass tube and use glass plates, and still, if we could have the Bucky diaphragm, we would do just about as well as now; but take away the Bucky diaphragm and we would be greatly handicapped. Our plates, Dr. Kirklin's and Dr. Carman's, are of the standard, but do not think for a moment that I believe Dr. Carman, Dr. Kirklin and I can do 50 per cent better technical work, but if we make a happy average of his figures and ours, we are going to have a good average together. So, I believe in the use of the

[1] See *Radiology*, Feb., 1924, p. 80.

Bucky diaphragm, without any question, for gall-bladder work and gastro-intestinal work.

Now the question of visible gall bladder —we all realize that the work started first with gallstones and then ran into the question of the visible gall bladder. We wanted facts to hold the indefinite shadow of the gall bladder—anything that would help toward a positive diagnosis. Then the secondary or indirect evidence was gradually developed.

Now on the technical side. I do not know how we can approach this at the moment unless we say this,—and I feel this sincerely,—that we can demonstrate gallstones and we can demonstrate, I think, as many as Dr. Carman has shown. I have not the figures to prove it at the moment, but I am sure we can demonstrate a large percentage of gallstones that exist. I am sure that we have pretty good records on visible gall bladders, and we know what that means, at least from our point of view. We have a great deal of evidence in the secondary manifestations and respect it as a very valuable part of the examination that includes the small and large bowel. If these have any value whatever,—and that depends on how much you consider they have,—the more they have just so much more has the negative value, on the basis of percentage. If we have no positive evidence, the absence of that positive evidence must give it some negative value.

Now, the question of fluoroscopic examination, which we do not do routinely, and one minor reason in these cases is this, that, in the first place, we give a larger amount of barium than the average man (about 21 ounces), to over-distend the stomach and duodenum, to exaggerate pressure deformity, adhesion deformity and ulcer deformity. We found that out by experience in the Army. The moment you see this pressure deformity and start to manipulate, it may entirely disappear and will not re-appear unless the gall bladder is confined by adhesions. It stands to reason, in the latter position, knowing the weight of the barium and the effect of gravity. It does seem to me reasonable that the normal gall bladder cannot push away the barium. That is without any great amount of bias, either way. My contention seems more reasonable than the others.

I hope, Dr. Carman, that next year you will read another paper on gall-bladder disease, in which the figures will be better. I hope ours will be as good as yours.

Dr. B. R. Kirklin (Muncie, Indiana): I wish to compliment the writers of this paper upon the splendid work they have done on this subject. I feel that they have made a very valuable contribution to the subject.

I personally have had considerable interest in this work and have looked forward with much pleasure to hearing this paper, for, as Dr. Camp told you, I spent a few months here, through the kindness of Dr. Carman and his associates. The memories of these few months are among the most pleasant memories of my professional life, for I thoroughly enjoyed my work in the Clinic, as well as the splendid associates, and I wish to publicly express my appreciation of the invitation to come here and carry on this small series of gall-bladder cases. I was also impressed with the fact of the fairness of Dr. Carman and his associates in wanting to get at the truth of this subject. I am sorry that this paper does not cover the secondary roentgenologic signs of gall-bladder disease along with the primary. I feel that the question of the visualized gall bladder representing pathology is pretty well settled, for as has been shown by the essayists, of the 169 cases in which they made an affirmative diagnosis, their diagnosis was correct in 97 per cent of the cases. The largest percentage of errors occurred with the negative cases and it is on these cases that I believe that the secondary findings would be of great value, so I shall confine the most of my discussion to that phase of the subject.

For the past three or four months we have been using at home a sheet to correlate

our secondary findings, and since checking these secondary findings, we have had 169 cases. Of these 169 cases we have reported gall-bladder pathology in 84 cases, or 49.7 per cent of the total cases examined. Of these 84 cases we made a diagnosis of gall-bladder pathology on the direct findings alone in 19 cases, or 22.6 per cent. Please note that in these cases we found nothing but the primary gall-bladder shadow or gallstones upon which to base our roentgenologic diagnosis of gall-bladder pathology. In 6, or 7.1 per cent, of the cases, we had no direct findings, but made the diagnosis entirely upon the indirect findings. In 59 of the cases, or 70.2 per cent, both primary and secondary roentgenologic gall-bladder signs were found. In several of our gall-bladder cases the primary shadow may not be definite enough to depend on alone and it is in these cases and in the ones with no primary shadows at all, that the secondary findings are of great help.

Now of the 59 cases mentioned, it would be interesting to know that in the anterior-posterior films we found pressure defects in the stomach in 4 cases, in the first portion of the duodenum in 13 cases, in the second portion of the duodenum in 4 cases, or a total number of pressure signs in 17 cases (20.2 per cent). In the lateral or oblique view we found no pressure defects in the stomach, but in 16 cases, or 19 per cent, we found gall-bladder pressure in the duodenum, making a total number of 33 cases, or 39.2 per cent, showing pressure signs in either the posterior-anterior or oblique views. Adhesions were shown in 6 cases in the stomach, and 23 in the duodenum. Of course, some of these patients showed adhesions in both stomach and duodenum. In 24 cases, or 29.4 per cent, gastro-spasm was present, at the antrum. I merely mention these secondary findings to prove that I have some confidence in their value, and I am satisfied that without their aid our percentage of correct diagnoses in our own work would be somewhat lower than it has been. In our own series, which I reported in 1920, before this Society and, also, before the American Roentgen Ray Society in 1922, we were able to diagnose correctly, approximately 92 per cent of the gall bladders which came to operation. I might also add that the gall bladders which we made positive findings upon in this series, and which were removed, were gall bladders which had gross evidence of pathology present, as ordinarily the surgeons will not remove a gall bladder that is normal to inspection and palpation.

I would like to show some slides illustrating some of the secondary findings as we interpret them. I have tried to include slides here that prove that the secondary findings shown are produced by gall bladders with visible stones in them, so that there can be no doubt but what it is the gall bladder that is producing the deformity.

In conclusion, I wish to emphasize the importance of making a complete roentgenologic study of the gall bladder on every gastro-intestinal case. We do this in our own work and it requires only about ten or fifteen minutes' additional time to make the primary gall-bladder films, as the secondaries will be picked up in the regular course of the gastro-intestinal examination. We also make no additional charges for a gall-bladder examination, thereby eliminating any pecuniary interest. I appreciate that it is easier probably for us to include a routine gall-bladder study at our private laboratories than it is in a large institution, such as the Clinic, for here the large number of patients requires an additional routine and much more time.

I wish again to express my appreciation to Dr. Carman and his associates for this splendid contribution, and assure them that I am looking forward with much interest to the carrying on of this work in this institution, because I feel that we all will learn a great deal from them in the future, as we already have in the past. I know very well that it will be given careful, fair and conscientious consideration.

DR. MACCARTY (closing): After studying the appendix for about nineteen years, at operation and autopsy, I must confess that the majority of us have diseased appendices. Whether these diseased appendices are making symptoms or not, I do not know, but I daresay I could make just as many correct diagnoses, on this platform, of chronic appendicitis, as any X-ray man in the audience. Now let us come to the question of the visible gall bladder being a pathologic gall bladder and by that I understand, at present, the X-ray visible gall bladder: I have seen more than 10,600 gall bladders and I have opened at least 90 per cent of these, personally. I have seen at least 90 per cent of these gall bladders before they were removed by the surgeon and I must say that I see gall bladders every day in my hand that I cannot swear are either pathological or normal. Now if you cannot make a positive diagnosis with the specimen in your hand, how can you expect somebody to do it by the shadows of an X-ray plate? It sounds very well but it does not seem reasonable. It does not seem to me that whenever we can visualize a gall bladder on a plate, we have a right to say that it is pathological unless we are willing to assume that practically all gall bladders are pathological, just as we almost have to assume in the case of appendices.

For some time, thanks to the inspiration of Dr. Carman and Dr. Kirklin, I have enjoyed following their observations, looking at some of the plates, which of course are unintelligible to me, and checking up some of the reports, being responsible of course only for the pathologic diagnosis in the case of the specimens.

Dr. Carman, Dr. Camp and I had a series of gall bladders, most of which Dr. Camp has told you about. I have checked nearly 500 gall bladders which have been irradiated and in which we have X-ray diagnoses or X-ray findings. I have personally reexamined and measured every specimen and tried to grade each one on a scale of four, four representing the worst, and one, the least pathologic condition. I have also observed whether or not stones were present. My study of these cases was carried on independently of the method used by Dr. Carman and Dr. Camp.

All the gall bladders which I am talking about are definitely pathologic. There were 71 diagnoses of stones in this series by the X-ray man, 70 of which were correct. In other words, 70 gall bladders had stones and one had not, which is a very encouraging figure. In 211 gall bladders with stones there were 120 positive X-ray diagnoses, or 56.8 per cent. There were 86 negative X-ray diagnoses and five were put down as suggestive. There were 86 specimens with gallstones in which the X-ray man did not find the stones.

We hear a great deal about the size of the gall bladder in relation to these findings, and I might say now that the normal gall bladder is about 6½ to 7 cm. long and from 2½ to 3 cm. in its largest diameter. Now in order to make up some observations, I took only the specimens which were more than 8 cm. in length, remembering that some of these were as large as 15 mm. in length. There were in this series 98 which were over 8 cm. in length, and of these 48 had positive X-ray findings and 50 were negative. Of the 48, 41 contained stones and seven did not and of the negative cases 35 contained stones and 15 did not.

Now we hear about the diameter, the distention of gall bladders, and so I am observing them from the standpoint of their largest diameter, which is ordinarily from 2½ cm. to 3 cm. I took all the gall bladders over 4 cm. in diameter, which were nine in number. Out of these nine very large gall bladders there were three with positive X-ray findings and six with negative X-ray findings.

We are attempting in this study to find out just why it is that we do see the gall bladder. Dr. Camp has mentioned the question of the bulk and thickness of the gall bladder, and I want to show you some figures relative to thickness. The normal

gall bladder varies from 1½ mm. to 3 mm. in thickness and I have taken only those which are thicker than 4 mm., they being pathologic. There was a total positive diagnosis of 65 and a total negative diagnosis of 64. In other words, when the gall bladder has a thick wall we have 50.3 per cent diagnosed positive and 49.6 per cent diagnosed negative on X-ray findings.

Now let us speak of the pathologic gall bladders which have a practically normal thickness (2 and 3 mm. thick). In the first series there were 19 positive rays out of 49, and 30 negative rays, a percentage of 38.7 and 61.2. These were the specimens in which no stones were present. If we study the same series in which stones were present, we find the positive X-ray in 37 and the negative in 21 out of the 58 specimens. If we combine these, out of 108 there were positive X-rays in 57, or 52.7 per cent, and negative rays in 51.

I do not know whether you are all familiar with the term "strawberry" gall bladder or not. It is a term we gave a certain gross pathologic condition in the gall bladder about ten years ago, and is a definite pathologic entity which we can recognize. Grossly there were in this series 69 of these "strawberry" gall bladders in which the X-ray was positive in 33, negative in 31 and suggestive in five. Of these, 40 had stones.

In studying Grade 3 and Grade 4, which are definitely bad, we find that there were 45 positive with a positive X-ray out of 92, and 46 out of 92 with a negative X-ray. In Grade 2, the intermediate group, but which is definitely grossly pathologic, the X-ray was positive in 53, negative in 28 and suggestive in five, out of a series of 86. In Grade 1, where it is difficult frequently to make a gross pathologic diagnosis, we have resorted to a dissecting microscope in studying these specimens grossly, and I might say that we do not see quite as many normal gall bladders as we saw when we made the investigation of the 500 gall bladders that Dr. Camp has mentioned. Out of the 144, there were 49 with a positive ray, 84 with a negative and 11 with a suggestive ray.

Now if we sum all of these figures up, I should say that our batting average at present is about 50 per cent, which is almost in accordance with the figures of Dr. Camp.

DR. L. T. LEWALD (New York): I would like to ask a question in regard to whether any attempt to study the chemistry of the bile and the gallstones has been made. I gathered that something has been attempted.

DR. I. SETH HIRSCH (New York): The subject of the X-ray diagnosis of gall-bladder disease is of very great practical importance, particularly to those engaged in large X-ray laboratories. Where considerable numbers of cases presenting what are usually described as gall-bladder symptoms, are sent for an X-ray examination with the object of determining the condition of the gall bladder, the question arises: Shall the examination be made as a separate examination, or as a part of the general gastro-intestinal tract examination, or should both examinations be made in every case, and is it of importance to pay any attention whatever to any sign in reference to the gall bladder except the presence of calculi shadows? It becomes an open question in view of Dr. Carman's and Dr. MacCarty's findings (of the general frequency of gall-bladder disease), whether it is worth while subjecting a large gastro-intestinal material to the special gall-bladder examination for the purpose of determining a lesion which is so easily diagnosed clinically, and so simply determinable in a negative way by exclusion of organic lesions of the stomach and duodenum. If by excluding organic disease of the gastro-intestinal tract it becomes possible from a mere consideration of the clinical symptoms to diagnose gall-bladder disease with a great accuracy, and if in 97 per cent of positive X-ray diagnoses and 82 per cent of negative X-ray diagnoses, according to the so-called direct and indirect signs the gall bladder is found pathological, then is the

effort devoted to the special examination worth while? The history of the whole question of gall-bladder diagnosis has been one of stumbling and gyrations and somersaults, etc., because I believe we have put the cart before the horse and usually have had the outfit driven by over-enthusiastic drivers. What I mean is this: The essential basis for our whole roentgen diagnostic system is based on the pathology of the organ we are investigating. The first consideration, therefore, should be given to the determination of what is the preponderating pathology found at operation or postmortem in cases having local and general symptoms referable to the right upper quadrant that are free from acute inflammation, ulcer or neoplastic disease, and are clinically diagnosed as gall-bladder disease. If the great majority of such patients have certain pathological changes in the gall bladder, and these changes are responsible for the symptoms, then it is for us to determine just what radiological signs are associated with such pathological changes. But the history of the X-ray examination of gall-bladder disease appears to have developed the other way. First, it was the dramatic demonstration of gallstones, and on limited numbers of cases, varying from 20 to 40, statistics were constructed and percentages deduced which led one to believe that in the vast majority of cases gallstones were easily diagnosable. When, however, increasing numbers of cases, by various observers, rendered these percentages untenable, indirect signs were hurriedly called to the aid of the diagnosis. Signs that had been known for years, and previously held in scorn, were quickly marshalled to protect the dwindling front. Now new statistics were advanced, and when these failed to hold up the line, the gall-bladder shadow itself was made to act as the last reserve. Now we find that there are no pathognomonic signs (except gallstones) of such disease and that, after all, this diagnosis may be made merely by exclusion. This being so, it becomes an extremely simple matter to make a diagnosis of a pathological gall bladder, and on negative signs alone in association with clinical data it appears one can attain a high percentage of correct diagnoses. What, then, is the problem? The problem, then, is to determine the extent of the disease, and it is to that end that we must perhaps improve our method of examination. For surely neither the size nor the shape nor the position of the gall bladder is of any importance in this respect, nor do the present indirect signs help us. An important finding in this direction is the presence of gallstones. I think about 38 per cent positive diagnoses in gallstones about expresses the general average throughout the country, or perhaps throughout the world, as a result of good routine work. There are individual investigators who show a higher percentage, but these are in particularly selected cases, radiated and reradiated with a great deal of care, more attention being given to the case than can be given to the average patient in a large, busy laboratory. I do not deny that it may be possible by an improvement of the technic to improve these statistics. At the present time, however, we must consider that these statistics are about correct. In reference to the indirect signs,—my own feeling is that they are of very little value as permitting the determination of the actual pathology of the gall bladder, though they may be of value in explaining the symptoms in the particular case. For hypertony and hyperperistalsis and esophageal regurgitation (which is only the result of the hypertony) all must manifest themselves symptomatically, though they have no specific bearing on gall-bladder disease. They are associated with that radiological complex known as duodenal irritation. They may be absent with well-marked gall-bladder pathology and present with a normal gall bladder. In consideration of the significance of the pressure deformity of the duodenum, or antrum, it must be remembered that the gall bladder does not remain statically filled, but empties and fills again, perhaps two or three times during the day, and that this depression in the duodenal outline signifies nothing but the state of overfilling either the gall bladder or the antrum and bulbus. It may be

present with a normal as well as a pathological gall bladder. A gall bladder may contain many stones and much bile and not show any duodenal depression or any displacement of the duodenum or hepatic colon; and duodenal pressure deformity and displacement, even when determined fluoroscopically, are consistent with normal gall bladders. In reference to the gall-bladder shadow, I absolutely convinced myself several years ago that the normal gall bladder may be visualized in individuals who have never had any gastro-intestinal symptoms. We were able to demonstrate the gall-bladder shadow in quite a percentage of absolutely normal individuals, and I am sure that with careful technic and at a favorable moment, a normal gall bladder may be demonstrated in a large majority of individuals. Nevertheless, the outlook on this whole question should be a hopeful one. My own feeling is that we ought to concentrate on the study of the general gastro-intestinal examination, doing the special gall-bladder examination only when the general examination suggests stones, and to strive for an improvement in technical methods, whereby we may be able more accurately to determine the extent and severity of the disease.

DR. CAMP (closing): In answer to Dr. LeWald's question with regard to the chemistry of the bile: We are also determining the viscosity of the bile, and the specific gravity, and are also sending these specimens to the chemical laboratory for complete chemical analysis. As stated in our paper, we have not examined a great number of cases so far and do not care to give conclusions at this time.

ELECTROTHERMIC METHODS IN THE TREATMENT OF NEOPLASMS AND OTHER LESIONS, WITH CLINICAL AND HISTOLOGICAL OBSERVATIONS[1]

By WILLIAM L. CLARK, M.D., J. DOUGLAS MORGAN, M.D., and EUGENE J. ASNIS, M.D., PHILADELPHIA

IT is quite obvious that one who depends upon a single method in the treatment of malignant disease may not hope to obtain anything but a limited degree of success.

Experience has taught us that operative surgery, electrothermic methods, radium, and X-rays are all factors of such importance that none of them can be eliminated from our armamentarium if the maximum of success is to be realized.

Fig. 1. *A.* Small round-cell sarcoma of bulbar conjunctiva and cornea.

Fig. 1. *B.* Result of one desiccation treatment under local anesthesia. There is no perceptible scar and no impairment of vision.

All of these methods are employed in our institution, either alone or in combination, to meet particular indications; and we have learned from experience that, if it were necessary to eliminate any one of them, we should be seriously handicapped in our work.

The status of surgery, radium, and the X-rays is well known, owing to the wide and continuous promulgation of knowledge concerning them in medical schools, and through the writings of capable exponents. Permanent recognition of these methods is assured, since their great value has been demonstrated by numerous critical tests.

Knowledge concerning the electrothermic methods is, however, not so general, owing, perhaps, to meager teachings in medical schools, to a dearth of authentic literature upon the subjects, to prejudice against any method employing electricity, to want of standardized and efficient equipment, to improper technic (hence poor results and fallacious conclusions), and to the failure of the comparatively few who do employ them correctly to report their work in a convincing manner.

Experience over a period of many years has definitely demonstrated to us the extreme importance of the electrothermic methods. We consider them as second to none and, indeed, in many emergencies superior to all.

Thus, the strong conviction that the importance of these methods of attack should be emphasized has inspired the present contribution, which will be devoted to the rationale, equipment, technic, clinical and histological observations, with indications for, and contra-indications to, their employ-

[1]From the Clinical and Research Departments of the William L. Clark Hospital. Read before the Radiological Society of North America at the Mayo Clinic, Rochester, Minnesota, Dec. 5, 1923.

ment. The types of cases in which these methods stand supreme will be stressed, with the hope of encouraging serious consideration of their unique advantages, and

Fig. 2. *A.* Squamous cell epithelioma of the nose, upper lip and septum.

of demonstrating a sound clinical and histological basis for their employment.

To avoid confusion and that our terms may be clearly defined, we emphasize that fulguration (as originally described by de

Fig. 2. *B.* Result of one desiccation operation under local anesthesia.

Keating Hart), thermo-cautery, galvanocautery, and electrolysis are entirely dissimilar and, in our experience, inferior to the methods under discussion.

Two definite tissue changes, produced by high frequency currents, will be considered. These we classify descriptively, in accordance with the actual effects produced in

Fig. 2. *C.* Artificial nose attached to spectacle frames.

the tissues, as desiccation and coagulation, respectively.

The desiccation method is one by means of which benign, or malignant, growths of small, or moderate, size may be destroyed by the utilization of heat of just sufficient intensity to desiccate, or dehydrate, the tissues. The heat is produced by a monopolar high frequency current of the Oudin type, the current being conducted to the lesion by means of a steel needle, or other pointed metallic applicator. A single spark gap is employed in the circuit. The desiccation effect, as originally described, was produced by a high-tension static current transformed into a high frequency current of suitable quality by means of Leyden jars of sufficient capacity, and a resonator supplying the proper inductance. However, since the advent of the modern transformer type of high frequency machine, it has been found that desiccation can be satisfactorily produced with this latter apparatus. The principal disadvantage of the former lay in the fact that static currents, being influenced by atmospheric conditions, were often not available in humid weather. High-speed

static machines are also expensive, and occupy considerable floor space. Modern high frequency apparatus is, on the other hand, compact, comparatively inexpensive, and uninfluenced by weather conditions.

There is an impression among many that the desiccation and the coagulation methods are one and the same. This is an error, since the effects produced upon the tissue are quite different. This can readily be demonstrated both clinically and histologically. The Oudin current, by which desiccation is produced, is of relatively high voltage and low amperage; whereas, the d'Arsonval current, by which coagulation is produced, is of lower voltage and higher amperage.

A milliampere meter cannot be used to measure a monopolar current. The proper current strength necessary to d e s t r o y growths of different types and sizes can be learned only by experience. The desiccation effect may be produced in the tissues by delivering the current through a short air space, by just touching the surface, or by inserting the needle more or less deeply, depending upon the degree of destruction desired.

The desiccation method is used advantageously when the lesion is localized and when good cosmetic results are not only desirable but essential. It is subject to such perfect control that an exceedingly small growth even on the cornea may be successfully treated without impairment of vision by the subsequent formation of scar tissue; or, a small growth on the vocal cords may, likewise, be destroyed without impairing phonation. The comparatively slight trauma to the tissues, and the little secondary inflammation, explain, from an histological standpoint, the slight scarring and the success obtained in treating these delicate structures.

After unbiased and critical comparisons it may be asserted that no other method is comparable in efficiency to that of desiccation in the following conditions: localized benign growths of the larynx, bladder, or rectum; exostosis of the hard palate, or Paget's disease of the nipple, can be completely destroyed by this method with a minimum of trauma to the contiguous healthy tissues; equally good results are obtained in the treatment of lesions as refractory as corneal ulcers, ptergium, zanthoma, and trachoma; minor gynecological conditions, such as cervical erosions, urethral caruncles, etc., yield readily to desiccation treatment; moles, papillomata, angiomata, nevus pigmentosus, leukoplakia, lupus vulgaris and erythematosus further exemplify the great variety of pathological conditions where this method may be successfully used. The desiccation method is also an important factor in the treatment of malignant lesions of the skin and mucous membranes.

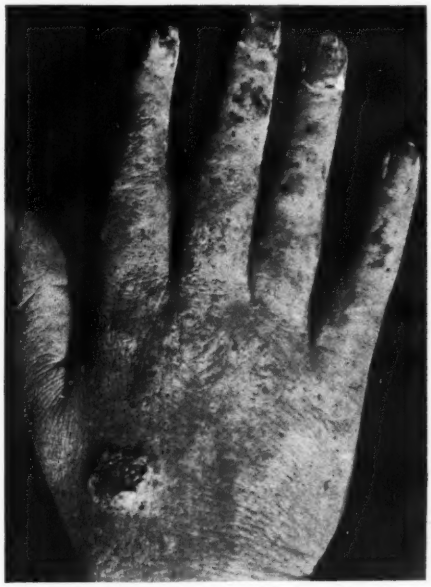

Fig. 3. Typical picture of chronic X-ray keratoses of the finger and hand, with the development of a squamous cell epithelioma. In these lesions no method has proven so satisfactory, in our experience, as the desiccation method.

It is further desirable to give special mention of this method in the treatment of hemorrhoids and infected tonsils. In the case of hemorrhoids the patient is prepared in the usual manner. A one-half of 1 per cent solution of procain is used for local

anesthesia, by standard technic. The sphincter is then dilated and the hemorrhoids pulled down by means of tenaculæ and clamped in the direction of the muscle fibers, as in the clamp and cautery operation. The desiccation current is then used to destroy the hemorrhoids. Because of the deeper sealing of the hemorrhoidal veins, hemorrhage is practically eliminated. The minor trauma to which the tissues are subjected induces but a mild local inflammation; hence, little post-operative discomfort and no unpleasant sequelæ, such as contracted cicatrix with subsequent stenosis. This method has, in our experience, simplified the treatment of even the worst cases of hemorrhoids.

Fig. 4. *A.* Basal cell epithelioma involving the ear and surrounding tissues, the mastoid bone, also the ear canal almost down to the tympanum.

Fig. 4. *B.* Demonstrating refinement of control and the result of one desiccation operation under ether anesthesia. Both facial nerve and hearing were conserved.

Surgical tonsils in adults, in which there is some constitutional contra-indication to surgical enucleation, can be very satisfactorily treated by the desiccation method. The operation may be performed with the patient seated. The reflexes in the throat are inhibited by the topical application of a 10 per cent solution of cocaine, and the tonsils, which are not ordinarily very sensitive, are sufficiently anesthetized by the application of the same solution. A portion, or the whole, of the tonsil may be sterilized and, if desired, destroyed down to the capsule. Tonsillectomy may be done quite as radically as by any other surgical method with the advantage that the patient suffers only slight post-operative discomfort. There is no contracted cicatrix, no impairment of voice, and the results are comparable to, indeed, surpass, any other method of which we are cognizant. An article appeared in a recent issue of the *Journal of the American Medical Association,* in which electrocoagulation was condemned in the treatment of surgical tonsils. The fact is that electrocoagulation should not have been used in the treatment of infected tonsils. Had the writer been familiar with results obtained with the milder desiccation method, he would have been as enthusiastic over the good results thus obtained as he was severely critical of the others.

Coagulation is produced by a bipolar high frequency current of the d'Arsonval type, utilizing a multiple spark gap. It is more penetrating and intense than the desiccation method and, in accessible locations, is utilized to destroy larger growths, even those involving bone.

There are many variations of technic in the application of this method to suit the requirements of the individual case. These

cannot well be described, but must be learned by practical experience. It may be stated, however, that the active electrode should always be pointed. Steel sewing needles of various lengths may be thus employed or, if still greater length is required, steel knitting needles, or stiff wire cut to any length, may be used, either straight or curved, so as to be adapted to particular anatomic locations. Since the effect of high frequency currents is entirely thermic, and not electrolytic, it matters not what metal is used. As it is not possible to thoroughly insulate these electrodes, care must be taken that only such tissues as are undergoing treatment shall be touched. The indifferent electrode, which is necessary in this method, may be of any material that will conduct electricity, such as a metallic plate, or, as we prefer, a moistened asbestos pad. This should be placed in close contact with the skin of the patient's back. Both the active and indifferent electrodes are connected by insulated wires to either side of the d'Arsonval winding of the high frequency machine. Good contact in all the circuit connections is of great importance. A meter should be connected in this circuit as a guide to the current strength employed, which varies, according to the size of the growth to be treated, from about 200 to 2,500 milliamperes. The meter is, however, not an infallible guide in estimating the action of the current, since the reading is also influenced by the size of the patient under treatment, or, in other words, by the amount of resistance in the circuit.

Doyen's method of coagulation consisted in the use of a blunt metallic electrode upon the growth, and of another of the same, or larger, size, at some point near the growth.

Fig. 5. *A.* Large round-cell sarcoma involving the face, the antrum, the malar bone, the floor of the orbit, the ethmoid, as well as all the tissues within the orbit.

Fig. 5. *C.* Result of one coagulation operation under ether anesthesia. Artificial features by the sculpture method are very satisfactory in similar cases. (In our opinion this is the type of lesion in which the coagulation method stands supreme. No other method could be employed so successfully.)

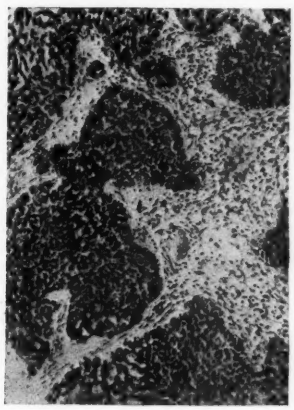

Fig. 5. *B.* Photomicrograph of section taken from this lesion.

It has, however, been found that the control by this technic is imperfect, and experience has taught us that the pointed active, and the large passive, electrode is a superior method of application. While the current

Fig. 6. *A*. Very advanced basal cell epithelioma involving the tissues of the face, nose, septum, antrum, malar bone, whole orbit, ethmoid, frontal sinus, extended to the inner canthus of the left eye.

is passing, the needle may either touch the surface of the growth, or be inserted into it, depending upon the depth of destruction desired. In the case of pedunculated growths, a metal snare may be used to advantage as the active electrode. As already stated, the d'Arsonval current, by which coagulation is produced, is of relatively low voltage and high amperage. If a short air space intervenes between the growth and the needle, the current will be conducted to the tissue in the form of convective sparks which sometimes approach the intensity of a flame, depending upon the frequency of the oscillations in the current. Under such circumstances the coagulation will be superficial. If the active electrode remains in contact with the growth, heat will be generated in the tissues without the production of sparks. Under these conditions the tissues will be quite deeply coagulated, the actual depth depending upon the duration of the application. Better control of this can, however, be accomplished by inserting the needle into the tissues to the desired depth. Unlike the heat generated by these high frequency currents, that produced by the actual cautery is comparatively superficial in action. The former is

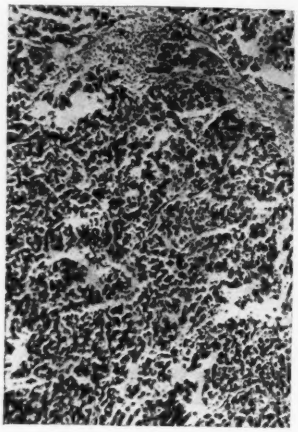

Fig. 6. *B*. Photomicrograph of section taken from this lesion.

generated within the tissues by their resistance to the current, while the latter is merely transmitted by contact.

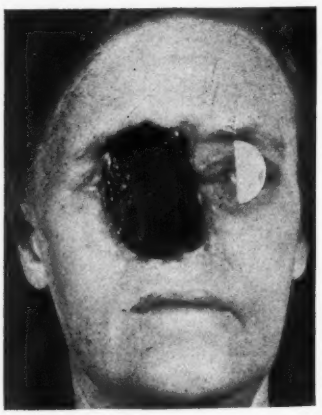

Fig. 6. *C*. Showing the result of one coagulation operation under ether anesthesia. Again as in Fig. 5 *A*, *B*, *C*, the coagulation method was particularly indicated and the same result could not be accomplished by any other method.

Whether employing the desiccation or the coagulation method, the aim should be to destroy the growth at a single operation.

Following devitalization by either method, the destroyed tissue should, as a rule, be immediately removed by excision or curettage, usually without hemorrhage. If necessary, the base may then receive further

Fig. 7. Showing the result of a coagulation operation upon a very advanced basal cell epithelioma involving the upper lip, nose, septum, antra, ethmoid, frontal sinus and the left orbit.

treatment. When, however, the mucous surfaces are involved, owing to the greater danger of secondary hemorrhage in these localities, the destroyed tissue is, with few exceptions, allowed to slowly separate. When sufficient intensity of current is employed, bone will separate within several weeks. If important blood vessels are implicated, it is a safe procedure to ligate them preliminary to treatment.

In dealing with localized, benign or malignant, lesions, the superiority of the electrothermic methods over radiation treatment is shown by definite histological changes, and by comparison of permanent clinical results. With electrothermic methods the diseased tissue, only, is destroyed, conserving the vitality of the surrounding normal structures. Subsequent treatments, should they be necessary, offer equally good prospects of success as though the tissue had not received previous treatments. On the other hand, with radiation treatment of sufficient intensity to influence a malignant growth, it is impossible not to lower the vitality of the surrounding normal tissue, to a certain extent, and, in case of recurrence, little more can be hoped for from further radiation treatment, owing to the resulting fibrous changes. This is a fact well known to radiologists. On account of these resulting changes, radiation treatment should not be used in conjunction with electrothermic methods in localized, benign or malignant lesions. There are many cases in which the electrothermic methods are not applicable and where radiation treatment is preferable, but our experience has been such that we feel very strongly that the electrothermic methods alone should be used in the type of lesion mentioned.

High frequency machines, as devised by different manufacturers, vary greatly in construction; hence, there is a corresponding variety in the quality of the currents produced. The thermic intensity is often too great, or too little, and an undesirable faradic effect, producing shocks and contraction of the tissues, is experienced when improperly constructed machines are used. This want of standardization is unfortunate, since, to produce the desiccation or coagulation effect under the best conditions, a very accurate balance must be maintained between the voltage and the amperage, and, also, between the capacity, inductance, and the resistance. Thus, different operators, employing different types of apparatus, may obtain different results. A machine giving a satisfactory therapeutic current may not be suitable for good surgical work. We have, for example, found it necessary to have machines constructed according to definite specifications to enable us to obtain the various factors necessary for our particular requirements. However, even with a machine constructed on correct lines, the difficulty of application lies principally in the acquirement of a proper technic. Much harm can be done by an operator without practical knowledge of the various factors involved. This warning is timely, since a considerable number of cases come under our observation that have been improperly

treated with high frequency currents. We have also heard these methods condemned by capable surgeons who have employed them, but, upon studying their technic, it has been easy to comprehend the reasons for their dissatisfaction with the results obtained. One who sincerely studies these methods cannot fail to be impressed with their merits.

Fig. 8. *A.* Demonstrating result frequently obtained in carcinoma of the hard palate, alveolus and antrum by the coagulation method.

Fig. 8. *B.* Denture, preventing food from entering the antrum and assuring normal speech.

Electrothermic methods can be best practiced only by those who have had surgical training and experience. They are quite as surgical in practical application as operative surgery, requiring the same precise knowledge of anatomical landmarks, and the same surgical judgment, that every good operator must have. The probable reasons for the apathy that exists in regard to these methods are, that surgeons do not realize their potency, and that those who use them without surgical accomplishments frequently fail in their practical application.

The efficiency of these methods is increased in some cases by the judicious combination of operative surgery, radium, and the X-rays. The electrothermic methods should be used alone, only in localized tumors of a type which do not tend to metastasize. The basal cell type of epithelioma occurring on cutaneous surfaces, such as the face, eyelids, etc., even though extensive, and with involvement of bone, may be so thoroughly treated by the desiccation or coagulation method that recurrences are infrequent. This conclusion has been reached from the careful observation of the results of such treatment in over three thousand cases of this type.

In localized squamous cell epitheliomata on cutaneous surfaces, or mucous membranes, the results obtained are almost as good as in the basal cell type. However, when the growth is no longer localized and metastasis has occurred, other methods must be used in addition. A fair measure of success is obtained even in these cases. The grading of tumors according to Broder's method gives some indication as to prognosis, and has an influence on the choice of treatment.

Electrothermic methods are peculiarly adapted to the treatment of localized malignant growths occurring in any part of the oral cavity. In the treatment of growths of the urinary bladder, larynx, etc., suitable endoscopes must be employed to render the growth accessible for treatment. The choice between local or general anesthesia is governed by the same principles as in operative surgery.

As an example of an operation by the coagulation method, amputation of the tongue will be described. If the case is far advanced with considerable general emaciation, it is our practice to do a preliminary gastrostomy. This has several advantages, namely, it permits of the building up of the patient's strength, relieves the pain incident to swallowing, and frequently results in a considerable reduction of the swelling and induration in the tongue and pharynx following the rest given to these parts. The tongue can readily be coagulated through its base and then excised, with infrequent primary or secondary hemorrhage; but, to completely obviate these dangers, it is considered safer to do a preliminary ligation of the lingual, or of one, or both, external carotid arteries. Ether anesthesia is employed. The ether should, however, be removed from the room when the patient is fully under its influence and before applying the current, else it might ignite. Should the operation be unusually prolonged and the patient show signs of regaining consciousness, it may be temporarily discontinued as often as required, and ether again administered. As a rule, however, this operation is of such short duration that the use of ether a second time is not necessary. Scopolamine, gr. 1/100, and morphine, gr. 1/4, may in some instances be used hypodermically one hour before the administration of ether. Less ether will be necessary under such conditions and the immediate post-operative discomfort minimized. After separating the jaws with a mouth gag, a heavy silk suture is passed from side to side through the tip of the tongue, by means of which it is drawn well forward. The coagulation needle is then brought in contact with the anterior surface of the tongue as far back as is necessary and the current turned on either by the operator, by means of a foot control, or by an assistant, on signal. The needle is then moved across the tongue and carefully inserted into it at different points, allowing coagulation to take place as it moves. This having been thoroughly accomplished, the tip of the tongue is elevated by means of the suture and a straight, sharp sewing needle, of proper length, is substituted for the curved knitting needle previously used. The frenum is then coagulated and the needle inserted between the tongue and the floor of the mouth. When coagulation is again completed, curved scissors may be used to cut through the coagulated areas on both surfaces, and the tongue then separated from its attachments. After-treatment consists of simple antiseptic mouth washes and the application, two or three times daily, of Dakin's solution, or one of its modifications, which sterilizes, deodorizes, and tends to keep the slough firm and free from maceration. Care should be taken not to remove the slough prematurely, else secondary hemorrhage may occur. When a preliminary ligation has been performed this, of course, is not so much to be feared. Such a major electrothermic operation should be performed in a well appointed operating room, using the same preparatory technic as in any surgical operation.

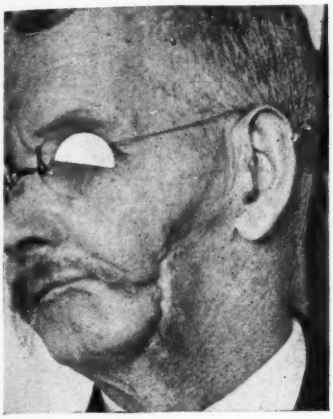

Fig. 9. Illustrating result obtained in extensive squamous carcinoma involving the buccal surface, extending through the cheek and most of the lower jaw, with metastasis to the cervical glands. The initial lesion, including the bone, was first coagulated, the jaw resected later. Radium needles were employed to treat the metastatic glands with X-ray treatment from other portals. A year later a plastic operation was performed, utilizing a flap from the chest.

In addition to the desiccation or coagulation of the affected tissues, and the sealing

of blood and lymph channels, the heat penetrates beyond the area totally destroyed and devitalizes malignant cells, without permanently impairing the healthy tissue, thus lessening the likelihood of local recurrence, or metastasis, and conserving the maximum amount of normal tissue. Malignant cells, especially those that are least differentiated, are more vulnerable to heat, and are devitalized at a lower degree of heat than are normal cells. This thermic sensitiveness to the action of the high frequency current has often been observed clinically and demonstrated histologically. The success obtained in the treatment of malignant disease by the desiccation and coagulation methods is explained by the fact that all the malignant tissue was, when possible, destroyed with one radical treatment. The practice of intentionally treating a malignant lesion by a series of desiccation or coagulation operations is, however, reprehensible and must be discouraged. It is quite as irrational to do this as to expect success by surgically excising a cancerous growth in a series of operations.

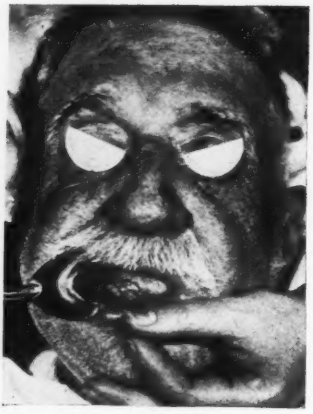

Fig. 10. *A.* Squamous epithelioma of tongue.

Fig. 10. *C.* After amputation by the coagulation method. Soft pliable cicatrix.

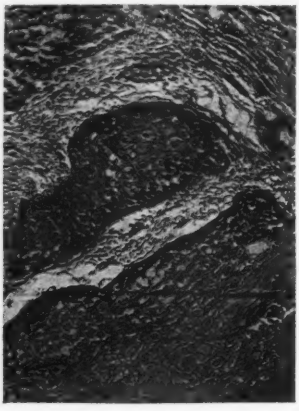

Fig. 10. *B.* Microscopic appearance of the tumor.

Fig. 10. *D.* Showing artificial tongue made of moist cotton, materially improving speech.

HISTOPATHOLOGIC STUDIES

In the vast majority of instances, histologic studies of neoplasms are limited to diagnosis. Since the advent of radium and X-rays, not a little attention has been given to the microscopic changes in the tumor tissue submitted to the action of these agents, namely, the hydropic and fatty metamorphosis of the cytoplasm, the pyknotic nuclei, the round-cell infiltration and the vascular and fibroblastic changes. As far as we know, no studies have been made of histologic changes in neoplasms following the use of the desiccation method, first described by one of us (Dr. W. L. Clark), and that of coagulation, originated by Doyen. During our usual routine of examining tumor tissues for diagnostic purposes, the peculiar appearances of the cells submitted to desiccation and coagulation were observed to be entirely unlike those treated with radium and X-rays. This led us to further investigation.

Clinically summarized, the aim of the electrothermic methods is to destroy malignant cells, to seal blood vessels, and obtain a healing wound with the least amount of cicatrization.

In order to correlate the histologic findings with the clinical results obtained, microscopic examination of tissues exposed to desiccation and coagulation currents were undertaken. The material used consisted chiefly of epitheliomata (basal and squamous type), and the normal tissues of laboratory animals. The investigation entailed the study of the effect of the current on the cells and blood vessels in the immediate and remote areas of the fields of operation. The histologic pictures thus obtained were so well defined and uniform as to stamp them with definite characteristics. The cells submitted to the desiccation current were shrunken and shrivelled, and their nuclei condensed and elongated, the whole assuming a mummified appearance (mummification necrosis). Some of the blood vessels were thrombosed, the walls remaining intact, and there were no evidences of external hemorrhage. In the case of coagulation, cell outline was entirely lost, the affected tissue elements seeming to have fused into a structureless homogeneous mass presenting an appearance not unlike that of hyalinization. The majority of the neighboring blood vesels were thrombosed.

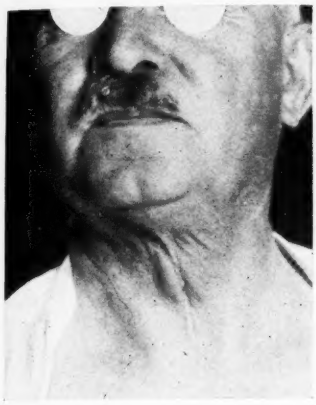

Fig. 11. We no longer attempt to treat malignant disease of the larynx through the mouth by any method. A tracheotomy is first performed, later a laryngotomy (longitudinal slit operation). The lesion is exposed and palpated, and if localized may be desiccated. Small radium needles may be used as a supplementary measure. The above illustrates a case of carcinoma of the larynx treated this way with no recurrence in over three years. In more advanced cases a laryngectomy may be indicated, followed by radium, X-rays, or both.

Fig. 12. Illustrating a type of carcinoma of the breast in which the coagulation method is indicated in combination with radium, X-rays, or both.

Since the neoplastic tissues examined were those obtained at the operating table, no opportunity was afforded to observe if any cell reaction had occurred in the zone of irritation adjacent to the area treated.

Fig. 13. Squamous carcinoma of the clitoris and labia. The desiccation method is indicated to treat lesions of this type, supplemented by deep X-ray therapy to the lymphatic drainage areas.

For this purpose guinea pigs and rabbits were used. Small areas of skin, subcutaneous tissue, and muscle were submitted to desiccation or coagulation currents and the animals returned to their cages. Several days later sections of these areas were removed for study. They revealed practically the same tissue changes already noted,

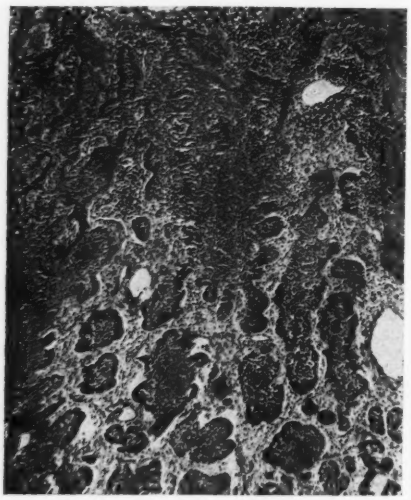

Fig. 14. Section of basal cell epithelioma removed before the application of the desiccation current, showing bulky masses of infiltrating basal cells.

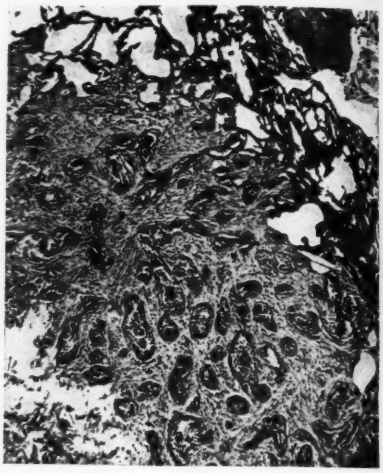

Fig. 15. Same growth as Fig. 14, showing the effect of the desiccation treatment. The cellular masses are definitely shrunken, the individual cells shrivelled, and the nuclei condensed and elongated.

but, in addition, round-cell infiltration was observed in the outlying zones, and in certain of the microscopic fields this infiltration was localized around the blood vessels.

How may one interpret these histological findings in terms of clinical values? In other words, what are their practical applications?

While it is outside the province of this paper to enter into a discussion of general pathology, it is deemed essential to call attention to a few fundamental pathologic principles in order better to correlate these histopathologic and clinical aspects of the electrothermic methods.

In general, degeneration and necrosis are caused by irritants. An irritant is any agent, or factor, capable of causing a biochemical upset, and is responsible for the histologic changes in the tissues. A degenerative process once initiated, and persisted in, leads to cell necrosis. The necrotic material eventually disappears, and the destroyed cells are replaced by connective tis-

sue. The amount and quality of this connective tissue is in proportion to the amount and nature of the degenerative and necrotic material which it replaces. Irritants resemble each other in that they induce degeneration, necrosis, and cell infiltration. They differ from each other in the form of degeneration and necrosis, and in the type of cell reaction. Whether the degenerative process shall be fatty, hyaline, or amyloid, or the infiltrating cell be a polymorphonuclear, lymphocyte, endothelial, or eosinophile, etc., or whether the fibroblastic proliferation be diffuse or localized, is determined largely by the type of irritant and its mode of action. Hence, the multiplicity of the various histopathologic phenomena. These, together with the associated secondary changes, give the histologic picture its specific character.

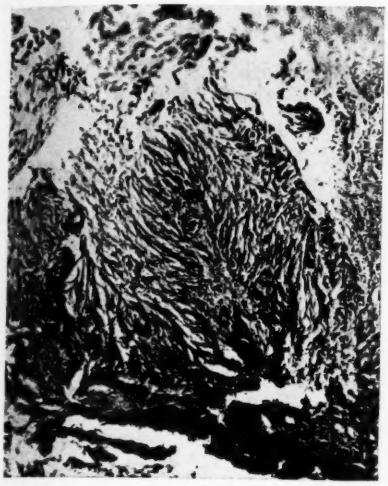

Fig. 16. Basal cell epithelioma, showing the characteristic appearance of the affected tumor elements. The cells appear as long-drawn-out slender threads, the whole presenting a mummified appearance. (Mummification necrosis.)

Viewed in the light of general pathology, typhoid, tubercular, luetic, and diphtheretic lesions present the same basic tissue changes, namely, necrosis and cell reaction, the difference being in the types of degeneration, of necrosis, and of cell reaction. Their distribution and particular localization endow these lesions with specific characteristics.

The secondary and associated changes of all lesions are regeneration and fibrosis. Whether the fibrous connective tissue shall be abundant and dense, or less abundant and soft, depends upon the amount and nature of the associated degenerative necrotic materials, which, in turn, is determined by the particular type of irritant. For example, compare the cheesy necrosis of a tubercle, the necrotic material of a gumma, and the pseudomembrane of diphtheria with their respective associated fibrosis.

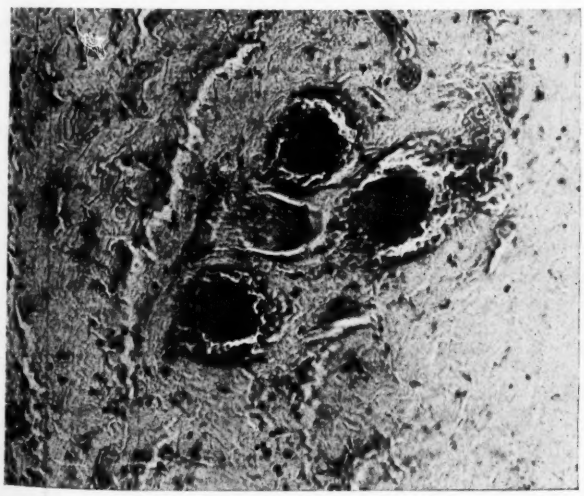

Fig. 17. Squamous cell epithelioma treated by the coagulation method, showing the microscopic appearance of an extensive area resembling hyalinization, and several sharply defined thrombosed vessels. The tumor cells seem to have fused into a structureless homogeneous mass.

The relationship between the type of irritant and the tissue changes induced is so intimate and constant that, given a particular histologic picture, the causative irritant is at once evident. The above mentioned lesions are good examples. Briefly stated, indicate the type of irritant, and the type of lesion can be described. Conversely, give the histology of the lesion, and the nature of the irritant will be revealed.

It is these fundamental principles of pathology upon which the microscopic studies were based, and it is in this sense that tissues treated by electrothermic methods present histologic pictures which are of such uniformity and constancy as to endow them with specific histological characteristics, namely, the shrunken and elongated appearance of the cells and their nuclei, and the round-cell infiltration in the case of desiccation; and the complete loss of cell outline and hyalinized appearance of the tissue, and thrombosis of blood vessels, in the case of coagulation.

The electrothermic methods are dependent for their results upon the resistance of the tissues to the current, which manifests itself in the formation of heat.

In the case of desiccation, the current being of comparatively low amperage, only a moderate degree of heat is produced, of sufficient intensity, however, to cause complete evaporation of the water content of the cells, hence their mummified appearance. Since the mode of cell death is associated with very little degenerative change and scant disintegrated material, there is but a small amount of fibrous tissue as an end-result, hence the good cosmetic results and, incidentally, the neighboring healthy tissues are spared the devitalization resulting from the formation of abundant contractile fibrous tissue. The coagulation method, requiring a higher amperage, induces a more intense heat, so that it not only dehydrates the tissues but causes coagulation of the cell protoplasm. This greater degree of destruction results, as we have learned to expect, in a proportionately greater amount of fibrous tissue formation.

Thus, in conclusion, not only are the aims attained, as stated at the outset of this paper, but the entire method is placed upon an histologic basis and correlated with clinical results.

LICHEN SIMPLEX CHRONICUS OR NEURODERMATITIS

By C. AUGUSTUS SIMPSON, M.D., and CLAUDE C. CAYLOR, M.D., WASHINGTON, D. C.

LICHEN simplex chronicus, the subject of this paper, is, in our experience, quite common among private patients and should be of some interest to radiologists. It is almost always associated with a great irritability, and highly nervous state of the patient. The high-tension, present-day living conditions offer a suitable soil and predisposition to the lesion. It seems that since the war the number of cases of lichen simplex chronicus in our practice has greatly increased.

The nosology of the disease is difficult for it has no special demonstrable anatomical connection with the nervous system nor is it a typical lichen; on the contrary, it is classified as a pseudo-lichen. Indeed, some specialists deny the entity of the disease altogether, claiming that it is nothing more nor less than a chronic eczema. At present, however, the younger medical minds are changing, and falling in line with Vidal and Brocq, of the French school, who were first to describe the disease twenty years ago. Jadassohn, of the German school, is of the same opinion. Wise and Heighman, in this country, are in accord with the French school.

Every attempt should be made to clarify the confused eczema group by eliminating this quite different lesion and classifying it as pseudo-lichen, where it belongs.

Lichen simplex chronicus (Vidal) is a dry, thickened, itchy, discolored skin lesion which may be circumscribed or diffuse, usually seen in patients between twenty and forty years of age, and has a special predilection for certain portions of the body. It is usually found in nervous, high-strung patients, or those showing signs of nervous fatigue and exhaustion.

The sites of predilection are the neck, flexors of the elbows and knees, the scrotum of the male, the labia majora of the female, the upper and inner surface of the thighs and the lower outer surface of the lower leg. A special location is the mid-line of the occiput, just within the hair border in women. Here it occurs as a thickened, leathery, corrugated, rather circumscribed, itchy patch, at times the size of a lemon. The pruritus may torment the patient to the point of weeping. Secondary impetigo may result from the scratching and infection. The hair on the area becomes thin and broken off one or two centimeters from the surface of the scalp, but usually returns when the lesion is cured and itching ceases. This is rather a common skin lesion among women. I have never seen a typical case in this location on a male patient.

ETIOLOGY

Violent emotions, worry, shock, undue apprehension, fatigue and exhaustion can be demonstrated in a great majority of the patients. They are notably bad sleepers. Asthma, hay fever and bronchitis are sometimes present. Overeating or the ingestion of highly seasoned, hot dishes may precede the attack.

DIAGNOSIS

Mode of onset.—First there is an attack of severe itching, usually over one of the sites of predilection, while the skin may show no visible change. The itching continues perhaps for weeks before the integument loses its normal color, becomes irritated, dusky pinkish in color, and shows a variegated, uneven, granular surface. The skin feels hot, dry and slightly thickened when pinched between the fingers. Its suppleness and elasticity are destroyed and it becomes leathery and coarse. At no time are there vesiculation, acutely red papules, pustules or weeping, such as are so characteristic of eczema. As the lesion develops the pigmentation increases, the thickening and infiltration progresses, and the normal lines of the skin become more exaggerated. These crisscross in all directions and become deeper and much more conspicuous. The areas of thickened, darkened epidermis

between these lines take on a flat, papular appearance with square corners and quadrangular in shape. These are faceted together in a mosaic arrangement with sharply defined edges, while their surfaces change from a granular appearance to that of a highly burnished, polished, glistening one.

Pigmentation continues to increase, along with the infiltration, and the lesion at last comes to a stationary stage, when it resembles a piece of elephant's hide inlaid in a section of healthy and normal surrounding skin. The areas are usually oval, five to six centimeters long, invariably dry, slightly scaly or burnished, and usually torment the patient with the most intolerable itching. The pruritus is of a peculiar explosive, paroxysmal type, alternating with periods of quiescence if undisturbed. Touching the lesion, removing the bandage, or getting warm in bed ready for sleep will often start the most exaggerated spell of itching, which causes the patient to excoriate himself to the point of drawing blood from the area.

A diffuse type may be present on and attack almost any portion of the body. Its general and widespread distribution seems to curtail the amount of pathology, so that the disseminated type rarely exhibits the exaggerated degree seen in the circumscribed form.

Larger diffuse areas of burnished lichenification, often symmetrical, dusky red and furrowed, may be present on the neck, behind the ears and on the flexors of the arms and legs.

The papules become more numerous and larger, the skin rougher, thicker, and less elastic, the pigmentation increases, while the pruritus continues. Scratching excoriates the lesion, but does not lead to vesiculation and crusts as in eczema. As the duration and severity increase, the thickening and pigmentation progress, the furrows become more numerous and deeper in certain locations, and the diffuse type may present areas which are subjectively and objectively as severe as are to be seen in the circumscribed type. In this stage the lesion may be taken for a lichen planus or a chronic eczema.

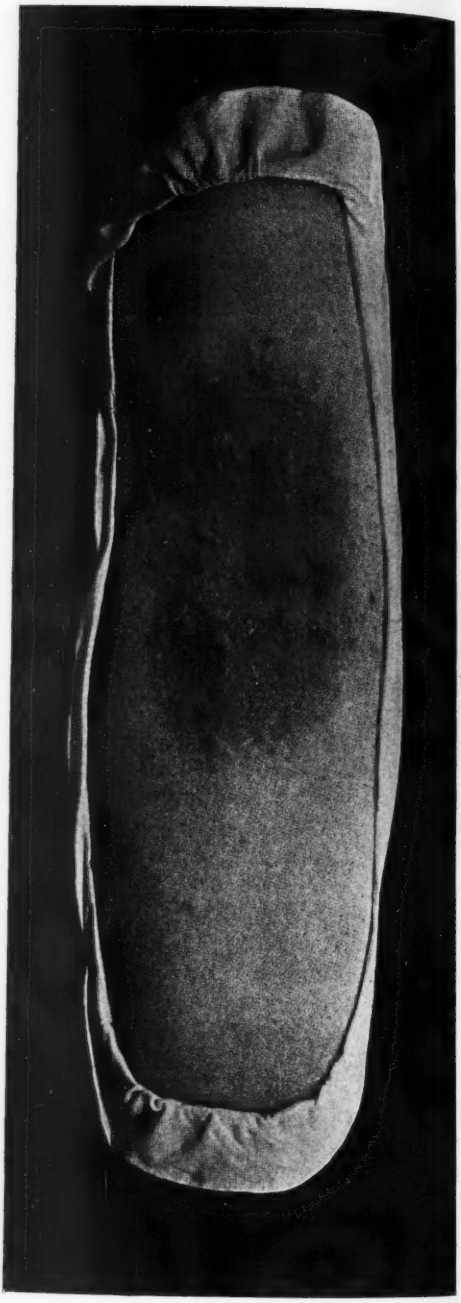

Fig. 1. Lichen simplex chronicus (Vidal).

Against the diagnosis of lichen planus may be noticed the absence from the wrists

and mucous membranes of the mouth, the polygonal, many-sided, more neoplastic type of papules in lichen planus.

The violet tint, central umbilication and peculiar grayish streaks seen in accumu-

Fig. 2. Lichen planus.

lated papules of lichen planus are never seen in lichen simplex chronicus. On the lower limbs, it is never seen in the hypertrophic, or warty form, such as lichen planus may exhibit. Lichen simplex chronicus is more frequently seen in young adults and elderly patients than lichen planus. To-day it is much more frequently encountered in our practice than is lichen planus, and, finally, it is less influenced by external and internal medication than is lichen planus.

Lichen simplex chronicus can be differentiated from eczema by the absence of the violent acute objective symptoms of inflammation. As we have stated, one does not encounter acutely red papules; the small, spontaneously or easily ruptured vesicles; the moisture and weeping; the sodden, macerated epidermis; the yellowish crusts nor the vague, ill-defined and discrete lesions seen in eczema. It seldom or never involves the flexors of the small joints, as the

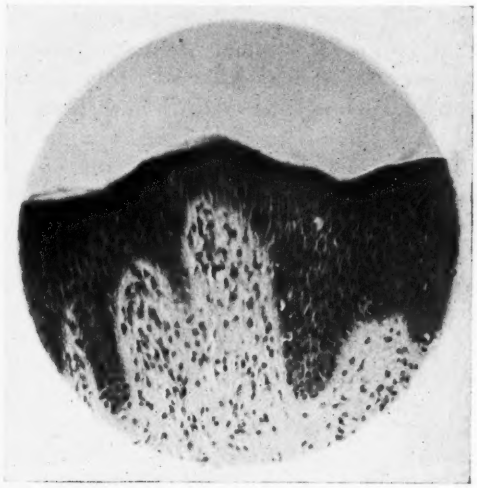

Fig. 3. Lichen simplex chronicus, showing elongated pegs, moderate, not dense, corium infiltration, and absence of cleft of Joseph.

fingers or toes. These multiform symptoms of eczema may all be present in a patch of eczema of the size of a lime.

Lichen simplex chronicus develops and responds to itching by slowly developing and always dry infiltrated, somewhat circumscribed, roughened, lichen-like, flat groups of papules that become more dry, thickened, leathery and pigmented with the duration and severity of the disease. There is never to be seen the vesiculation, pustulation, weeping and crusts which are so characteristic of eczema. Finally, the response to treatment is quite different, lichen simplex chronicus responding to X-ray very much more rapidly than the usual case of chronic eczema. At the same time, we are aware of the advantages of irradiating certain types of eczemas.

The disease seems to be a primary pruritus on soil that responds with dry lichenification, instead of the classical catarrhal skin lesions present in eczema. This primary pruritus may last for months before

the typical pseudo-lichen appears, almost always associated with a great irritability and highly nervous state of the patient.

HISTOPATHOLOGY

Sections from both the circumscribed and diffuse types have been extensively studied in France and Germany. Wise, chief of the Vanderbilt Clinic, very kindly supplied the section that we have to show (Figs. 3 and 4).

Under low power the section of lichen simplex chronicus shows the papillæ to be from two to three times their normal length. As a result the rete malpighii dips down finger-like, some long and thin, others broad, branching and fused.

High power shows the horny layer to be thin and without parakeratosis. The granular layer averages two or three cells in thickness and is normal.

The prickle layer shows extensive acanthosis leading to increase in the bulk of the epidermis. Not only is there proliferation of the rete cells, but extensive edema both intercellular and intracellular. The prickles are put on stretch and in certain localities the cell protoplasm gives way to the edema, leading to spongiosis. The edematous cells are not so massed or extensive as are to be seen in eczema, nor are there more than a few leukocytes to be seen in these degenerated areas, another point which distinguishes it from eczema. Between the germinal layer and the papilla the edema may cause a separation of fibers, so that an occasional ill-defined space or lake may be distinguished. These spaces are always small and rudimentary when compared to the well-developed cleft of Joseph to be seen in the pathology of lichen planus. It is the caving in of the epidermal covering of the cleft of Joseph which gives one the clinical picture of umbilication in lichen planus, another very important point in the differential diagnosis of the pathology of lichen simplex chronicus and lichen planus.

The hair follicles and sebaceous glands are not involved or hypertrophic, as the microscope reveals in seborrhoeic eczema, also there is more acanthosis, while the distribution of fat in the scales of seborrhoeic eczema is never seen in lichen simplex chronicus. Every user of X-ray should

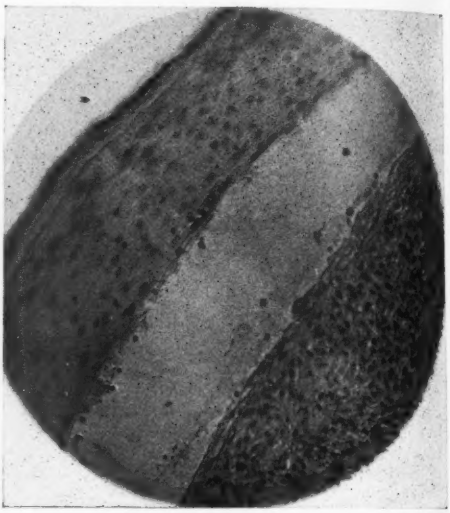

Fig. 4. Cleft of Joseph between epidermis and corium, also dense infiltration in subpapillary corium. Diagnostic points in pathology of lichen planus.

make a study of the clinical symptoms of this not uncommon lesion and be in a position to give that sure and quick relief which can come only from X-ray therapy. The indications and results are quite as apparent and striking as are those obtained in irradiating epitheliomata.

TREATMENT

The treatment of lichen simplex chronicus is the excuse of this paper. Many of these lesions have come to my notice recently where the treatment is entirely inadequate and far too mild to satisfactorily influence such a chronic, indolent disease.

Roentgen irradiation stands out as the most efficient form of therapy we have,—nothing else compares with it. In fact, it is my experience that the lesion is almost incurable with the usual salves and lotions and without the use of X-ray. Some years ago one of us (Simpson) had a patient, the wife of one physician and mother of an-

other, who had the lesion on her leg, persisting in spite of all manner and kinds of local and general treatment for forty years. She was given two three-fourths erythematous doses of X-ray at intervals of three weeks, and she has had absolutely no signs of return of the disease in five years. We can cite patient after patient with these lesions, who has been subjected to the expense and torment of this disease for months and years, simply because the specialist was not equipped or else was too timid to give his patient a real dose of X-ray. With the modern transformer there is no danger entailed and an erythematous dose is not necessary for results. Treatments should never be repeated more often than once in two weeks.

TECHNIC

The technic that we employ varies little from the one quoted by one of us (Simpson) in an article in May, 1911, and which the writer used in Max Joseph's Clinic of Berlin the year previous. It is also about the same as that found in Schultz' work on X-ray therapy which was translated and published in this country in 1913.

The German technic which the writer quoted was one-fourth an erythematous dose, unfiltered ray, using a 4-inch gap, 3 milliamperes and 12-inch distance. This was repeated every two weeks. At present we are using $\frac{5\times7\times1.30}{10\times10}$, with ½ mm. aluminum filter. We pay particular attention to the amount of infiltration and thickening of the skin. Using the modern transformer, instead of the old coil, standardization is easier. We feel justified in taking more liberties with the disease, and results seem to warrant this.

Naturally, pastille measurement of each dose of ray is unnecessary after one's machine has been standardized, its capacity ascertained and one's technic rigidly adhered to. The above amount of X-ray can be safely given every three weeks. It promptly relieves the itching, obviates the use of filthy, foul-smelling tar salves, quickly reduces the infiltration, and promotes the cure with less trouble to the patient and physician than any other form of therapy known. Unless X-ray is used it is quite possible that the lesion will persist for years with nothing more than temporary relief from salves and lotions.

If dryness or scaling of the lesion is objected to by the patient, advise the local use of cold cream or vaseline. No internal treatment is necessary as a rule. Rest from worries and business will help to prevent recurrences.

BLOOD COUNT AND BLOOD PRESSURE IN HIGH VOLTAGE THERAPY[1]

By ARTHUR U. DESJARDINS, M.D., Section on Radium and Roentgen-ray Therapy, Mayo Clinic, and
W. JAMES MARQUIS, M.D., Fellow in Roentgenology, The Mayo Foundation,
ROCHESTER, MINNESOTA

ACTION ON THE BLOOD CORPUSCLES

IN April, 1903, Senn reported that two patients with pseudoleukemia (Hodgkin's disease) had improved greatly under treatment by X-rays. In one case the blood counts before and after treatment showed an increase in the erythrocytes, and a marked decrease in the leukocytes. Owing to Senn's eminence as a surgeon, his communication attracted much attention and incited many workers to study the blood changes produced by exposure to X-rays.

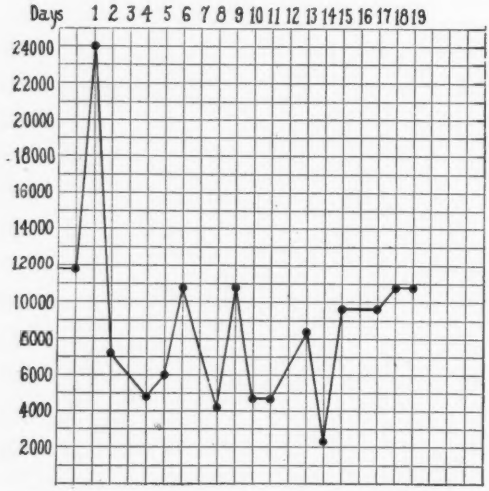

Fig. 1. Initial leukocytosis followed by leukopenia, then by a succession of rises and falls, and finally by stabilization at the normal level. The series of rises and falls have generally been interpreted as representing a compensatory effort toward re-establishing the normal state of the blood. Effect on total leukocytes of exposing a guinea pig to X-rays. (Taken from Aubertin and Beaujard.)

In the same year Heineke made a preliminary report of the results of extensive studies on the effect of X-rays on various organs and tissues, including the spleen and bone-marrow, and he likewise demonstrated a reduction in the circulating lymphoctyes, but the detailed report of his experiments and findings was not published until 1905. In the meantime (1904) several other workers (Guilloz and Spillmann, Aubertin and Beaujard (Fig. 1), Brown, Bryant and Crane, and Capps and Smith) had observed and called attention to similar blood changes in cases of leukemia treated by X-rays, their reports corroborating that of Senn.

In 1905, Helber and Linser demonstrated experimentally that in rabbits exposed to X-rays there occurs a marked reduction (in both absolute and percentage values) in the circulating lymphocytes. These findings have since been repeatedly confirmed and are now a matter of everyday experience.

In a noteworthy communication, published in 1906, with an extensive review of the experiments performed before that time, Warthin called attention to the fact that the action of X-rays on the bone-marrow is of the same character as that on the spleen and lymph glands, although much less intense. This contention was given additional support by the experiments of Taylor, Witherbee and Murphy, who asserted that "X-rays in large doses affect the lymphocytes before any of the other circulating cells." They also noted an immediate leukocytosis followed by leukopenia and later by gradual regeneration. (Figs. 2 and 3.)

Carrying their work into the experimental field, Aubertin and Beaujard not only confirmed the results previously obtained, but undertook to determine the mechanism involved. While much subsequent work has served to amplify our knowledge in this direction, the deductions derived from their experiments have, in the main, been generally accepted.

X-rays produce changes in most of the tissues of the body, but they are especially

[1]Read before the Radiological Society of North America, December 3-7, 1923, Rochester, Minnesota.

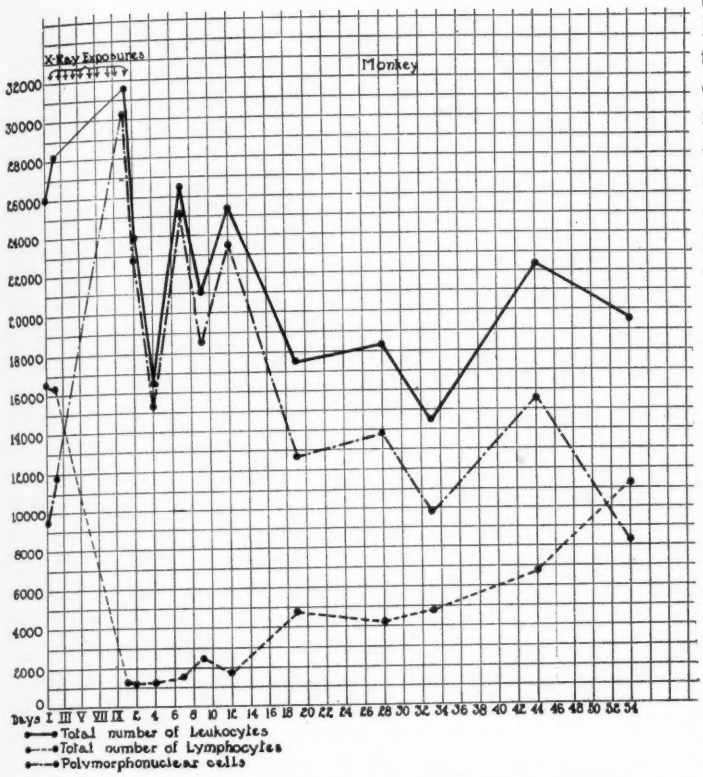

Fig. 2. The effect of a series of X-ray exposures on a monkey between the second and tenth day of the experiment. (Adapted from Taylor, Witherbee and Murphy.)

pronounced in the blood-forming organs and blood corpuscles, being immediate and much more intense than those observed in other tissues. They can be studied with considerable accuracy by repeated examination of the blood. When an animal is exposed to X-rays, either partly or *in toto*, for a certain length of time, there occurs, immediately or soon afterwards, a polynuclear leukocytosis which rapidly subsides and gives way to leukopenia. Simultaneous with, or even antecedent to, the increase in polymorphonuclear leukocytes there is a marked reduction in the number of lymphocytes. The time necessary to produce the leukocytosis, its duration, the degree and duration of the subsequent leukopenia as well as the degree and duration of the lymphocytosis depend on the dosage, and the part and size of the body surface exposed to the rays. These conditions are especially marked when the rays are directed to the spleen and bone-marrow. After a varying period of time regeneration occurs, the corpuscular elements gradually recovering their normal values.

Because of the marked degeneration of the lymph follicles which he had observed in the spleen and lymph glands, Heineke thought that the diminution in the circulating lymphocytes was due to the selective destruction of the lymphogenic tissues by the rays. Several of the authors previously cited also believed that the reduction in the leukocytes was due to a destructive action of the rays on the organs producing the white corpuscles: the bone-marrow for the polymorphonuclear cells and the spleen for the mononuclear cells. Such findings and conclusions may, perhaps, be accounted for by the fact that many of the earlier workers used enormous, lethal doses, exposing the entire animal. However, it was later found that more or less notable alterations in blood count could be obtained with much smaller doses; in fact, irradiation of single small fields over the spleen or bone-marrow is invariably followed by similar and more or less pronounced changes. In attempting to ascertain whether the lymphocytes are destroyed in the circulation, or whether such destruction is contingent on a primary effect of the rays on the blood-forming organs, Benjamin, v. Reuss, Sluka

and Schwartz, in 1906, by exposing only the ears of a rabbit for one hundred seventy hours (to compensate for the small surface exposed), the rest of the animal being carefully protected from the rays, found that

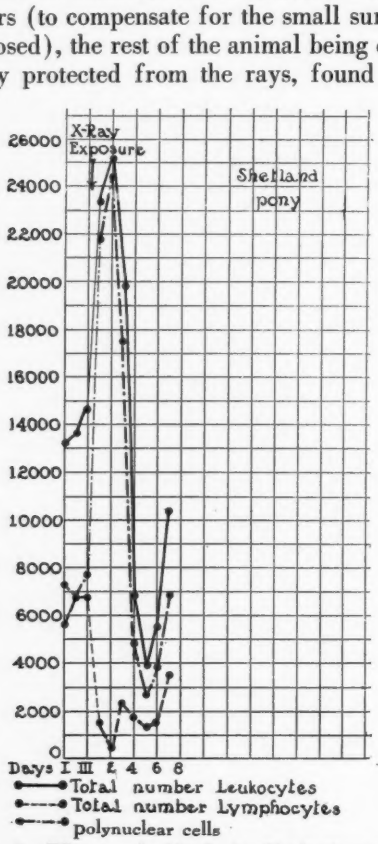

Fig. 3. Effect on the blood of a Shetland pony produced by a single exposure to X-rays. (Adapted from Taylor, Witherbee and Murphy.)

the subsequent blood changes were of the same character as those obtained by exposing the entire animal, except that regeneration was much more rapid.

Aubertin and Beaujard demonstrated that, if an entire guinea pig is irradiated for three-fourths of an hour with from 8 to 12 H units, a dose which produces no appreciable effect except in the bone-marrow, spleen and genital glands, one, two or three hours later a rapid leukocytosis follows, reaching 20,000, 25,000 or even 28,000, the increase being almost entirely in the polymorphonuclear cells. This leukocytosis is of short duration and is followed by a rapidly increasing leukopenia; so that, twenty-four hours after the exposure, the leukocyte count has fallen below its original value, and continues low for approximately fifteen days. According to these authors, the leukopenia is due to actual destruction of the white cells and not to lack of formation in spleen or bone-marrow. This conclusion is based on the fact that, during the period of leukopenia, the leukocyte count is not what it would be during diminished production by the marrow, because the granular elements are abundant and their number is increased, the polymorphonuclear cells reaching 55, 60 or even 70 per cent instead of the normal 35 to 40 per cent. The eosinophils increase up to 10 or 12 per cent, and the mast cells up to 4 or even 6 per cent. Such changes evidently indicate hyperactivity of the bone-marrow.

After the leukopenia has reached its lowest level, there follows a series of rises and falls, and later a steady regeneration. If the animals are killed at varying periods after exposure, such as during the stage of immediate leukocytosis, and of leukopenia, the bone-marrow, instead of showing evidences of degeneration, is found to be in a state of hyperactivity with loss of fat, increase in the number of myelocytes, a preponderance of polynuclear cells, and increase in eosinophils and mast cells.

During the first twenty-four hours after exposure, the spleen shows only a follicular hyperplasia which rapidly subsides, but during the period of leukopenia the pulp shows marked hyperactivity. Therefore, Aubertin and Beaujard concluded that the leukopenia is not due to degeneration of lymphoid tissue, since its lowest level coincides with the time when the lesions produced in the lymphoid tissue are repaired. Neither is it due to degeneration of the bone-marrow, because the leukopenia occurs in spite of a distinct hyperactivity of the marrow, which is in a marked state of hyperplasia when the leukopenia is greatest.

In 1919, Professor S. Russ reported a series of experiments showing that a short exposure to X-rays, from a few seconds to ten minutes, produces in the average rat a

50 per cent reduction in the circulating lymphocytes; that this reduction reaches its lowest level in about an hour, and that after from twenty-four to forty-eight hours the lymphocyte count is normal again. He also showed that prolonging the exposure to thirty minutes reduces the lymphocytes to the same degree, although in the latter the rate of regeneration is much slower; further exposure to X-rays during the period of depression does not cause the original reduction to become accentuated. However, he was unable to find, in the blood or other organs, evidence of increased accumulation or of lymphocytic destruction, and, therefore, could not explain the fate of the "knocked-out" (missing) corpuscles.

Leitch, in 1921, questioned the validity of the experiments of Russ and attempted to explain the leukopenia on the basis of reaction to fear. His contention was based on a small series of experiments, the results of which were rather inconstant and far from conclusive. Soon afterwards, Russ conclusively demonstrated the fact that the leukocytic reduction following exposure to X-rays cannot possibly be reaction to fear, because the rate of regeneration of the lymphocytes varies directly with the dosage, and that it is a better criterion of the changes produced than the immediate leukopenia.

The behavior of the red corpuscles under X-ray exposure has also been studied, but the reports thus far published indicate that such changes are slight and inconsistent. In 1908, Bergonie and Tribondeau failed to observe any alterations, either in whole blood or in defibrinated blood, after exposure to X-rays. In a more recent contribution, Westman reported a slight increase in the erythrocytes in some cases, but this finding was so inconstant that he was unable to draw from it any conclusion. He also confirmed the earlier experiments of Aubertin and Delamarre (1908) who showed that the changes in the cellular elements of the blood produced by radium are the same as those consequent on exposure to X-rays.

From the foregoing brief summary of available experimental evidence it appears conclusively established that: (1) exposure of the body to X-rays produces measurable alterations in the corpuscular elements of the blood, involving, first, the lymphocytes, causing a marked and rapid reduction, and second, the polymorphonuclear cells, causing a primary increase followed by a rapid diminution below the normal level, later by a gradual, although for a time not continuous, regeneration; (2) the degree of leukopenia following small and large doses is approximately the same, but the regeneration following large doses requires much more time; (3) such changes are not due primarily to a direct effect on the blood-forming organs, because similar changes can be brought about when both the bone-marrow and spleen are carefully protected from the rays; (4) exposure to X-rays has little if any effect on the red blood corpuscles; and (5) the blood changes produced by radium are essentially the same as those produced by X-rays.

Our interest in the action of X-rays on the blood was to ascertain whether similar changes occur in patients subjected to X-ray treatment, particularly at high voltages, and, if possible, to determine how closely such variations as are observed under clinical conditions correspond to those produced experimentally. However, it is important to bear in mind the fact that the experimental and clinical conditions are far from identical. In the former, normal animals are being dealt with; in the latter, persons who are the victims of disease, most of them suffering from the effects of malignant invasion, often complicated by infection or other confusing pathologic phenomena. Most of the patients had some form of malignant lesion of the pelvis or abdomen, although a few had benign tumors, such as uterine fibromyoma. In many instances there was more or less pronounced leukocytosis before treatment was started, and in such cases it was often difficult, or impossible, to determine the importance of individual factors.

In the series of cases studied, there were ninety-five in which careful differential blood counts were made before and after a course of X-ray treatment at voltages between 180 and 200 kilovolts peak. To make this study more interesting and conclusive such counts should be made repeatedly during and after the treatment, but this would have caused undue annoyance and hardship to the patients. In a few cases additional blood counts were made on the occasion of a subsequent course of treatment, after intervals varying between six and twelve weeks.

The experimental results cited led us to expect a uniform diminution in the lymphocyte count and an almost equally uniform rise and later a drop in the polymorphonuclear leukocytes after X-ray treatment.

In all but fifteen of the ninety-five cases, the X-ray treatment was followed by a more or less decided reduction (absolute) in the circulating lymphocytes. In eight of these fifteen cases there was an increase in both absolute and percentage values. In the remaining seven the absolute lymphocyte count was increased, but the percentage value was decreased. In three cases there was a percentage increase, but the absolute count had diminished. Consequently, in only eight of the ninety-five cases were the results at variance with the experimental data. Considered from the standpoint of percentage values, there was an actual increase in only eleven cases, in three of which the rise in percentage value was not accompanied by an absolute increase; in the eight cases, as mentioned, the increase was both in percentage and absolute values. In attempting to analyze these eight cases it was found impossible to determine any outstanding factor that would account for the variation in behavior of the lymphocytes.

There was a total absolute decrease in the polymorphonuclear cells in thirty-eight cases, but in only four of these was there an accompanying percentage reduction. A percentage reduction occurred in seven cases, but in only three of these was it unaccompanied by an absolute reduction.

From the foregoing it appears conclusive that X-rays, under ordinary therapeutic conditions, have a definite effect on the circulating lymphocytes as well as on the polymorphonuclear cells; but, if the results are analyzed only from the standpoint of absolute values, the polynuclear cells are much less influenced than the lymphocytes, since definite reduction in the total lymphocytes was obtained in eighty of the ninety-five cases, while polymorphonuclear leukocytosis appeared in only sixty-seven cases. It is quite possible that these results would have been considerably modified if counts could have been taken at more frequent intervals for a longer period of time.

If we consider the total white cell counts in which the experimental evidence would lead us to expect leukopenia, after an interval of twenty-four hours, the results of this study are far from uniform. Of the ninety-five cases there was leukocytosis in thirty-seven, and in three there was no change in the total leukocyte count. These results were also analyzed from the standpoint of the interval between the treatment and the enumeration; and from that of the condition treated as well as from the point of view of the treatment itself, but no definite factor was discovered to account for the discrepancy between the results in clinical treatment and those obtained under experimental conditions.

As far as the red corpuscles are concerned, such changes as we observed were quite variable. In many cases there was no appreciable alteration in the erythrocyte count; in some cases the erythrocytes were increased, but, in most instances, such increase was within the limits of counting error.

ACTION ON THE BLOOD PRESSURE

Since the advent of so-called high voltage X-ray therapy, we have been hearing and reading from time to time of the danger of exposing the adrenal glands, because they are supposed to be deleteriously affected by the rays. A review of the literature reveals surprisingly little experimental or clinical data to support this assumption. In 1912,

Zimmern and Cottenot studied a series of patients in a state of permanent hypertension in whom irradiation, limited as much as possible to the region of the adrenals, apparently produced a definite drop in the systolic blood pressure. In 1922, Coutard and Lavedan reported certain cardiovascular disturbances following the X-ray treatment of malignant tumors. The functional symptoms noted by them were shortness of breath, often to the point of dyspnea on exertion, together with muscular weakness, usually in the lower extremities. As physical signs they observed tachycardia, with or without arhythmia, reduction of the arterial blood pressure and a drop in the pulse pressure. According to these authors the symptoms vary in degree and duration, disappearing in about a month in the less severe cases. Holfelder also has called attention to the danger of irradiating the adrenal glands but has not given the data on which his statements are founded.

Our purpose in this study was not to prove or disprove experimentally the fact of an actual reduction of blood pressure following exposure of the adrenals to X-rays, but to determine if, under therapeutic conditions, such reduction does take place and what relation, if any, it may bear to the general condition of the patient. Systematic blood pressure estimations were made, not only before and after X-ray treatment at voltages between 180,000 and 200,000, but many readings were taken before and after each session. Of course, the clinical conditions surrounding the administration of such treatment of patients cannot possibly correspond to experimental conditions in which animals are used. Fifty-five patients were studied on whom approximately 500 blood pressure determinations were made.

From the point of view of the possible effect of X-rays on the adrenal glands, these fifty-five cases may be arranged, on the basis of the lesion present, in two groups:

Group 1. Lesions in the upper abdomen in which the X-ray treatment could conceivably or undoubtedly have acted on the adrenal glands; in this group only twelve cases can be included: lesions of the hypochondriac region, one case; carcinoma of the liver, one; carcinoma of the stomach, four cases; carcinoma of the colon (splenic flexure), two; hypernephroma, two; carcinoma of the right kidney, one case, and tumor of the abdomen (indeterminate), one.

Group 2. The remaining forty-three cases consisted of malignant involvement of the uterus, prostate, bladder, perineum, ovary, rectum, thoracic wall, scapula and ileum, and neck; in none of these could the adrenal glands have been directly implicated. All the cases were kept in the hospital during the entire course of treatment. In each case a blood pressure determination was made on the patient's admission, and in most cases a daily morning reading was made as nearly as possible at the same time, before the patients were out of bed. Additional blood pressure determinations were made immediately before and after each treatment session and in a certain number readings were also taken two or three hours after the treatment was started.

In only three of the twelve cases in which the adrenals could have been implicated was a definite drop observed in the blood pressure (systolic, diastolic, and pulse) after each treatment session as compared with that before the treatment was started. In three of the remaining nine cases there occurred after each treatment session a reduction in the systolic blood pressure only; the diastolic and pulse pressures remained stationary or were increased. In three other cases the majority of the readings after treatment were lower than those taken before the session, this varying to some degree in individual cases. Of the three remaining cases the systolic pressure after each treatment session was consistently increased in two cases, while in the third case the majority of the readings after treatment were increased. We may sum this up by saying that in six of the twelve cases the systolic blood pressure was uniformly decreased after each treat-

ment session, while in six others the results were variable.

We must now compare with the foregoing the results obtained in the forty-three cases, in which the adrenals could in no way have been directly implicated. In this group we find that in nine cases the systolic pressure was either increased or remained stationary, while in the thirty-four remaining cases either all or the majority of the systolic readings were lower after treatment than before.

Therefore, it appears evident from such results that X-rays generated at voltages between 180,000 and 200,000 peak do not influence the blood pressure to a greater degree when they are directed to the adrenal glands than when focused to some portion of the body quite remote from these structures.

In the course of this study we have made one observation, which is not at all new, but which has considerable bearing on the conclusions one might be tempted to draw; in the majority of instances (80 per cent) there was a definite drop in the blood pressure readings taken before the first treatment session, as compared with the pressure on the patient's admission. The fact that all of these patients were kept in bed during their entire course of treatment probably accounts for most of the reductions obtained. It must also be borne in mind that most persons about to undergo X-ray treatment are laboring under considerable nervous tension, caused either by the knowledge that they are victims of a malignant process with the resulting natural apprehension, or by fear of the X-ray treatment itself, or both. With the development of radiation treatment, to which many patients are now subjected, they have heard more or less about the sickness which often accompanies such treatment, and it is quite natural that they should dread the ordeal.

Our experience impels us to believe that the conditions under which treatment is given, necessitating the patient to be motionless on the table for a considerable period, should have much to do with such reductions in systolic blood pressure as are observed. Again, the routine diminished food intake for from two to three hours before and after each treatment session, as well as that resulting from anorexia, nausea, and vomiting, must tend to depress heart activity, with a consequent lowering of blood pressure.

Although we cannot disregard such cases as that reported by Smithies and the possibility of injury to the adrenals, the results of this study do not show any consistent reduction of blood pressure attributable to X-ray treatment. We feel justified in concluding that the factors herein enumerated, the patient's apprehension concerning his condition of ill health, and fear of X-ray treatment, tend to maintain at first a temporary increase in blood pressure, and that rest in bed, immobility during treatment and relative mental calm after they realize the painlessness of the procedures have probably more to do with reduction in blood pressure than a direct action on the adrenal glands.

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Deep therapy for cancer.—One hundred and fifty cases have been treated by the authors, who employ the technic sanctioned by the principles of deep radiotherapy. High voltage of 200 KV. short half-lengths and filtration equivalent to 13 mm. aluminum. The cancers treated were of the usual varieties clinically met with. From their experience the authors think that for tumors considered radio-sensitive, sarcomata and seminomæ, they have obtained good results with some cases quite irreducible despite the strongest doses employed.

In epitheliomata, tumors of the tongue have shown themselves refractory to deep radiotherapy, and adenopathies, when very voluminous, have not been sensibly changed by the treatment. Tumors of the pharynx and of the larynx, on the other hand, have been very favorably influenced.

In cancer of the breast the effects on the primary tumor or upon local recurrences have been rather inconstant. The treatment of cancer in this locality, besides, requires very delicate technic, as:

(1) For an anatomical reason, the considerable lymphatic territory of these tumors renders the complete irradiation of them difficult in the zones of permeability;

(2) For a physical reason connected with the insufficiency of the portals of entry which do not allow the deep penetration of the dosage considered sufficient without the fear of severe injury to the skin.

If treatment of tumors of the breast properly so-called is often followed by incomplete results, axillary and supraclavicular ganglionary propagations are, on the other hand, efficaciously affected.

For the rectum, treatment of deep radiotherapy has given the authors encouraging results. They think it can be used concurrently with radium advantageously. It reduces the danger of rectitis and gives more complete and extensive irradiation of the lymphatic pedicles.—*The Employment of Deep Radiotherapy in Cancer (Considérations sur l'emploi de la radiothérapie profonde dans le cancer). Proust, Mallet, and Coliez. Jour. de Radiol. et d'Electrothérapie, 1922, VI, 460.*

CASE REPORTS

CONGENITAL DIAPHRAGMATIC HERNIA

By OPIE W. SWOPE, M.D., WICHITA, KANSAS

This case, I wish to report not as anything especially new but rather to suggest the advisability of making examinations of infants who reveal some obscure condition not diagnosable by physical examination and other methods, as used by various specialists.

Fig. 1.

After reviewing literature and securing direct information from many prominent roentgenologists, we have discovered that while congenital diaphragmatic hernia is a rare condition, it is not so rare as we formerly presumed it to be. Much valuable information has been gathered over the last few years through the means of X-ray examinations, particularly during the World War. A large percentage of these hernias, however, were determined to be traumatic;

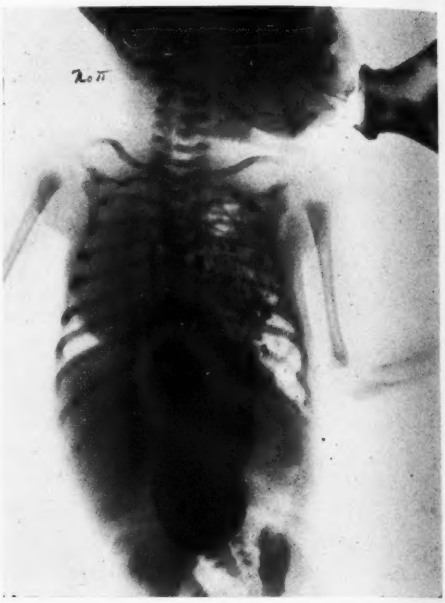

Fig. 2.

Fig. 3.

but it has also been proven that congenital hernias have persisted over a long period of time, in some cases the final and ultimate conclusions of which were arrived at by the X-ray method of diagnosis.

Fig. 4.

The case I here report was referred to the X-ray Department of the Wichita Hospital from the obstetrical service of Drs. John D. Clark and George A. Little. The case came without a conclusive diagnosis, but I learned afterward that a suspicion of something of the sort was the reason for suggesting this X-ray examination.

Oct. 31, 1923, no history given, Baby H., 4 days old.

A radiogram, No. 1, previous to barium meal, as is observed, reveals a distention of the left chest wall with many air pockets observed and extending up to the third interspace. Heart shadow pushed to the right

Fig. 5.

and almost to the right chest wall. Gas also is observed in an enclosure left of the lumbar spine (stomach). Patient was placed in antero-posterior position during this exposure.

With these observations in mind it was suggested to referring physician that a barium meal be administered which we hoped would prove our conclusion of diaphragmatic hernia, and also help to determine the portion of the bowel contained in the herniated region.

Two days after first examination a barium mixture was given in a feeding of mother's milk and observed under the fluoroscope. (Exposure No. 2.) During this procedure we find the gastric chamber

rotated forward, the lesser curvature posterior, the pylorus being obstructed from view, and barium content is observed passing into the jejunum. Baby was placed in a 45-degree angle and (No. 3) filling was revealed within a few minutes. A complete lateral view (No. 4 and then No. 5). All of this procedure extended over a period of less than one hour.

Our conclusion was congenital diaphragmatic hernia with the jejunum and portions of the large bowel herniated into the left thoracic region.

An autopsy a few days later proved our diagnosis.

So far as we have been able to ascertain no case of congenital diaphragmatic hernia younger than seven weeks has been reported, diagnosed by X-ray or other methods. Such a case was reported by Dr. O. H. McCandless in the *Journal of Radiology* some four or five years ago. Age of patient, seven weeks, with the hernia in the right thoracic region and very similar to our case.

MYOMA OF THE STOMACH AND OF THE DUODENUM

Report of Two Cases

By JOHN D. CAMP, M.D.

Fellow in Roentgenology, the Mayo Foundation, Rochester, Minnesota

In both of the cases reported herewith, the X-ray findings made it possible to diagnose the condition as benign tumor.

Case 1 (A432691). A druggist, thirty-nine years of age, came to the Clinic July 11, 1923, complaining of diarrhea and melena. He had first observed tarry stools three years before, and at this time he had been constipated. Shortly afterward the constipation alternated with diarrhea, occurring about every ten days, with occasionally tarry stools. One year before, he had had diarrhea for a month, with very dark stools, and had become very weak and anemic, but within a month he had regained most of his strength. Ten days before coming to the Clinic, he began to have diarrhea as before. He also complained of much gas and belching. He was able to eat all varieties of food, but said that he felt better

Fig. 1. A sharply circumscribed filling defect in the middle portion of the stomach, distal to the incisura angularis. The curvatures are not involved, although the lesser curvature is seen only faintly in the roentgenogram.

Fig. 2. Gross specimen in the case illustrated in Fig. 1. Ulcer crater at center of the tumor. This ulceration is quite characteristic of benign tumors.

with his stomach empty. He had lost but 10 pounds in weight.

The physical examination was negative. An examination of the urine was negative. The hemoglobin was 61 per cent, erythrocytes numbered 3,790,000, the leukocytes 9,800; the color index was 0.8. Examination of the gastric contents revealed a total acidity of 56, free hydrochloric acid 36, and a large amount of blood. The blood Wassermann reaction was negative.

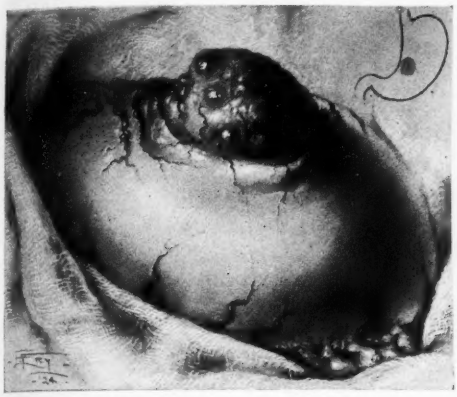

Fig. 3. Appearance of tumor on anterior wall at operation. The small figure in the upper right corner shows the approximate site of the tumor with the stomach in its natural position.

An X-ray examination of the stomach disclosed a more or less circumscribed filling defect in the lower third, and a palpable tumor corresponding to it (Fig. 1). Owing to the circumscribed appearance of the filling defect and the fact that the curvatures of the stomach were not involved, a diagnosis of benign tumor was made. An X-ray examination of the colon was negative. Operation was advised. The patient went home to arrange his affairs and returned for operation August 6, 1923. The hemoglobin at this time was 44 per cent, the erythrocytes numbered 2,850,000, the leukocytes 6,300, and the color index was 0.7.

At operation, a benign tumor which apparently involved all the coats of the stomach was found on the anterior surface, just off the lesser curvature in the middle portion of the stomach (Fig. 2). An examination of the liver was negative. A resection was performed through a median line incision, and an end-to-end anastomosis was made.

A pathologic examination of the specimen showed it to be an edematous hemorrhagic myoma 4 by 3.5 by 3 cm. with an ulcerated necrotic area on the mucous surface (Fig. 3). A microscopic examination of the tissue confirmed the gross diagnosis.

Fig. 4. Filling defect in the duodenal bulb, due to a tumor of the pylorus projecting into the duodenum.

CASE 2 (A434648). A farmer, forty years of age, came to the Clinic July 25, 1923, complaining of melena. Two years before, he had been buried in a gravel pit and extricated with some difficulty. Immediately after the injury he had a few attacks of vomiting. A few days later he felt a soreness in the right upper abdomen, and noticed that his stools were at times black and tar-like. Since then, he had always had a dull pain in the abdomen, especially one to two hours after meals, and associated with some bloating and belching. In December, 1922, after taking a laxative, he experienced a slight burning pain in the right upper abdomen. Suddenly, without

any exacerbation of pain, he began to pass tarry stools and became very weak and anemic. He went to bed and the hemorrhage became progressively less, so that in three weeks his stools were of a normal

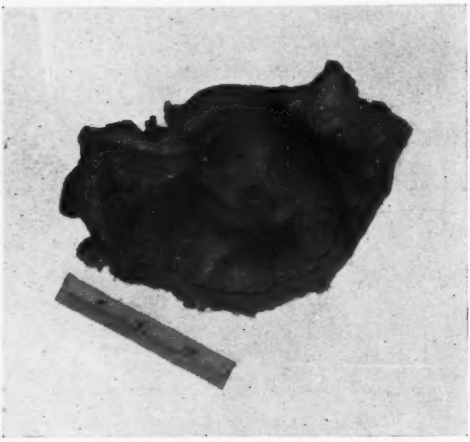

Fig. 5. Gross specimen of tumor illustrated in Fig. 4. Ulcer crater seen at center of the tumor.

color. He gradually regained his strength, but occasionally one to two hours after meals felt a slight burning pain in the right upper abdomen. He had become more constipated, and the bloating and belching were increasing in amount. Two weeks before coming to the Clinic he had had another hemorrhage, less severe than the first. He passed four or five tarry stools a day, became very weak and was in bed two weeks. Since then he had slowly regained his strength, but had taken very little food. The pain in the right side, and the bloating and belching persisted, but his bowels were less constipated. He had lost practically no weight.

Except for the presence of a slight anemia, the physical examination was essentially negative. The hemoglobin was 63 per cent, and the leukocytes numbered 5,900. On examination of the gastric contents, the total acidity was found to be 56, and the free hydrochloric acid 40. No blood or food remnants were found. An examination of the sputum was negative, as was also the blood Wassermann reaction.

An X-ray examination of the stomach and duodenum disclosed a more or less circumscribed deformity and filling defect of the first portion of the duodenum (Fig. 4). The X-ray diagnosis of benign tumor was made, and the presence of a papillomatous growth suggested.

Exploration of the stomach revealed a tumor in the pylorus and proximal duodenum, but no metastasis. The area of the tumor was purplish, and the veins around it were markedly congested and dilated. An anterior Polya operation was performed and the tumor completely removed.

A pathologic examination of the specimen (Fig. 5) showed it to be a myoma 2 by 2 by 1.5 cm., involving the first portion of the duodenum and the pylorus. On the mucous surface of the tumor was an ulcer 1.5 cm. in diameter. The pathologic examination of the tumor confirmed the gross diagnosis.

GASTROJEJUNAL ULCER: REPORT OF A CASE[1]

By DONNAN B. HARDING, M.D.

Fellow in Radiology, the Mayo Foundation, Rochester, Minnesota

This case is presented because of the atypical history, and the rather unusual operative findings. A man, aged forty-seven years, came to the Mayo Clinic in December, 1908, with a five-year history of occasional and indefinite abdominal pain, followed by one year of more definite symptoms, consisting of several attacks of epigastric pain, each about two weeks in duration, the pain coming on three hours after meals, and being associated with belching, pyrosis, food-ease, and vomiting. The patient had lost 15 pounds in weight, but regained it before coming to the Clinic. The general examination was negative. Gastric analysis showed free acid 80, and total acidity 94. A diagnosis of duodenal ulcer was made, and the patient returned to his home. A short time later he had two hemorrhages, with dark bloody stools for sev-

[1]From the Section of Radiology, Mayo Clinic.

eral days on each occasion. Returning to the Mayo Clinic in March, 1909, he was operated on, and a large perforated duodenal ulcer found. An anterior gastro-enterostomy was performed. The post-operative course was uneventful.

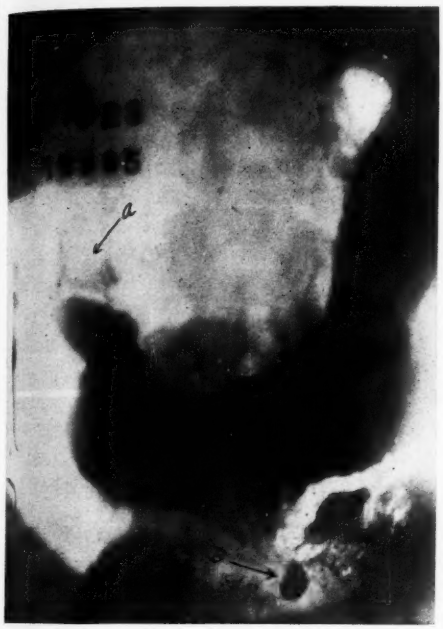

Fig. 1. *A.* Deformity of the duodenum due to duodenal ulcer. *B.* Niche of jejunal ulcer, which had perforated against the abdominal wall; note narrowing of bowel at this point.

During the next eight years, the patient was well, except for a few minor attacks of indefinite abdominal pain, at infrequent intervals and of short duration. In October, 1917, he accidentally found a mass in the left lower quadrant of the abdomen, and, two weeks later, sudden severe abdominal pain developed, associated with vomiting. Purgation relieved all symptoms in a few hours, and the mass disappeared. There was no further trouble until December 1, 1923. Then the attacks of vomiting and the mass in the left lower quadrant of the abdomen recurred, but without pain. For three weeks he vomited almost daily, losing 14 pounds in weight. His bowels moved regularly with the aid of mineral oil. On December 17, 1923, he again came to the Clinic. The general examination was essentially negative, except for a large right inguinal hernia, and a palpable mass in the left lower abdomen. The blood count was normal. Gastric analysis showed free acid 70, and total acidity 82. Roentgen-ray examination revealed characteristic deformity of the gastro-enterostomy stoma, marked narrowing of the proximal jejunum, and a fleck in the jejunum (Fig 1). On these findings a diagnosis of jejunal ulcer was made, and at operation there was found a large duodenal ulcer, and a gastrojejunal ulcer, which latter had perforated onto the anterior abdominal wall, with some narrowing of the gastro-enterostomy opening. Both ulcers were excised, the gastroenterostomy removed, and a gastro-duodenostomy performed. The pathologist's report on the tissues excised was duodenal ulcer and gastrojejunal ulcer.

SPASM IN THE MIDDLE OF THE ESOPHAGUS

By G. W. GRIER, M.D., Pittsburgh, Pa.

The following case is the first of the kind I have seen in my experience and for that reason I am publishing a brief synopsis in the hope that it may prove helpful to others.

Mr. A. V., age 55, blacksmith, of foreign extraction, always a very strong and healthy man, single, no venereal history; was referred by Dr. E. R. Gardner for X-ray examination Nov. 14, 1923, to find the cause of his difficulty in swallowing. He gave a history of having great difficulty in swallowing and constant regurgitation of food for the last two months, during which time he had lost 60 pounds in weight. Friends who were with the patient said that he had been indulging very freely in moonshine liquor for the past month or more. About four days before, the obstruction in the esophagus became so acute that he was unable to swallow liquid foods, or even water, everything he took being regurgitated. The man appeared to be in desperate circumstances; emaciation was extreme and he was

barely able to stand on his feet. When I gave him a liquid barium meal, he swallowed about half a glassful, which went down the esophagus to a point about the middle, where there was an absolute ob-

Fig. 1. Dilatation of the upper half of the esophagus above the spasm.

struction and nothing went beyond this point. It stayed at this point for some time, radiographs were made, and the barium meal was regurgitated while he was dressing after the examination was over. I reported an absolute obstruction at the middle of the esophagus, with the belief that it was due either to carcinoma or to syphilis. Wassermann reaction was made and found to be negative. He was placed in a hospital and immediately put on belladonna. He was allowed only liquid foods, a spoonful or two at a time. He did not vomit after being placed in the hospital and at the end of about three days, or as soon as proper arrangements could be made, an esophagoscope was passed and an absolutely normal esophagus was found. Not only was there no constriction or obstruction, nor any evidence of a lesion, but the mucous membrane in the esophagus was normal for its entire length and the esophagoscope passed into the stomach without any difficulty. A second X-ray examination made at this time showed an absolutely normal esophagus.

This was undoubtedly a case of spasm in the middle of the esophagus which had become so violent and constant as to actually threaten the man's life. He would certainly have succumbed in a few days if he had not been relieved. Spasm at the cardiac end of the stomach is not uncommon, but this is the first time I have encountered such a condition in the middle of the esophagus and did not know before this time that such a condition existed. The point I wish to make is that spasm may occur in the middle of the esophagus and the appearance may be exactly the same as in carcinoma and the clinical aspects of the case would substantiate such a diagnosis. This emphasizes the necessity for esophagoscopy in all lesions of the esophagus. With a negative Wassermann such as this man had, the only reasonable diagnosis of this case from the X-ray examination alone would have been carcinoma of the esophagus.

EDITORIAL

M. J. Hubeny, M.D. . . . . *Editor*
Edward W. Rowe, M.D. . } *Associate Editors*
Benjamin H. Orndoff, M.D. }

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The headquarters of the Radiological Society at the annual meeting at Kansas City will be at the Muehlbach Hotel.

Local Committee

Dr. E. H. Skinner, Chairman

Hospitality—Dr. O. H. McCandless, Dr. W. W. Duke.
Scientific Exhibits—Dr. Clyde Donaldson, Dr. Ira H. Lockwood.
Commercial Exhibits—Dr. L. C. Allen, Dr. David S. Dann.
Hall Committee—Dr. E. R. DeWeese, Dr. J. T. Swanson.
Hotel Committee—Drs. E. B. Knerr, W. T. McDougall, and Chas. E. Virden.
Hospital Clinical Committee—Dr. L. A. Marty, Dr. J. L. McDermott.
Liaison Committee—Dr. Geo. Knappenberger.
Publicity Committee—Dr. Geo. Knappenberger.

FUTURE OF THE ROENTGENOLOGIST

The practice of roentgenology is unique among the specialties of medicine in that it has no direct public appeal. Since the day of Hippocrates, the ethical physician has gained following and prestige entirely through the commendations of satisfied patients. The roentgenologist, however, is known to the patient only as one who cooperates with or assists the physician in making a diagnosis. The doctor, to the public, is still one who treats and attempts to cure disease, and since the roentgenologist is not such an one, there is no opportunity for him to build up a practice in the time-honored way. In the very nature of things, therefore, he is compelled to be a true specialist, receiving his support only through references by other physicians.

Here is food for thought. If there were no taint of commercialism in the medical profession of to-day, and the welfare of his patients were the sole concern of every ethical physician, roentgenology as a specialty would rest on a much firmer foundation than it does; because there can be no doubt that the practice of roentgenology, if it is to grow naturally and produce its best results, requires the enthusiastic and undivided attention of the specialist. But what seems to be the tendency of the day? Many hospitals with large staffs of physicians and surgeons have their X-ray laboratories under the supervision of non-medical technicians. They do this on the patently fallacious assumption that every visiting doctor is competent to make his own roentgenological diagnosis. It is a dishonest practice which involves the hospital authorities, the staff and the patient. The latter is led to believe that he gets what he pays for, a properly conducted X-ray examination. The hospital authorities make themselves a party to this deception solely on the grounds of commercial expediency; their X-ray departments pay much better if they do not have to employ roentgenologists. Why the hospital staff members do not rise up and protest is more difficult to explain. Do they not realize that their patients are paying professional fees to the hospital, while the only professional service, that of interpreting X-ray plates or fluoroscopic observations, is furnished by themselves? Some roentgenologists unthinkingly lend their aid to the deception by permitting their names to be used, as "Roentgenologist to the Hospital" without taking any active part in the management of the X-ray department or the determination of its policies.

There is to be noted a well-marked tendency on the part of internists, gastro-enterologists and groups to dispense with the aid of the roentgenologist. Since these men usually have a public following, only a small percentage of their cases being referred by other physicians, they are able to do this readily enough. If their X-ray

work is not efficiently done, no one is the wiser, since their diagnoses are only infrequently checked up by other clinicians. Is this tendency a healthy one? Does it make for the advancement of the science of roentgenological diagnosis or for greater efficiency in the practice of medicine? The answer to the last question answers the first. If the roentgenologist is forced to appeal to the public for his support, he must become a sort of super-internist who selects those cases for diagnosis and treatment in which the X-ray plays an important part. It would be much less difficult to make an internist of a well-trained roentgenologist than a roentgenologist of a man well trained in internal medicine.

F. S. BISSELL, M.D.

THE USE OF AMPLIFIERS IN GAMMA-RAY MEASUREMENTS

By N. ERNEST DORSEY, Ph.D., WASHINGTON, D. C.

I have just read with much interest Dr. Hess' article[1] on the use of triode amplifiers in gamma-ray measurements, and doubt not that several of the readers of RADIOLOGY will desire to try the plan suggested. It is a pity that Dr. Hess did not give us more details; that he told us neither the type of tube he used nor the precision he attained. I am especially sorry that he did not; because I tried the scheme for gamma-ray measurements shortly after it was first proposed by Brentano[2] for alpha-ray work, and I did not succeed in obtaining results that were satisfactory to me.

I used American-made tubes of types recommended for the purpose by one who had had a wide experience with the many types manufactured throughout the world. There was one particular type of English tube that he thought might possibly prove more satisfactory for this purpose than any of the domestic tubes. This tube I did not try; two were not readily available, and besides, I desired to use a set-up that could readily be obtained in this country. My ionization chambers were much larger than those mentioned by Dr. Hess, thus reducing the difficulties. In spite of this, the results were not satisfactory.

I do not say that triodes cannot be used for this purpose and in the way described, but only that the particular types that I tried cannot be so used unless only a relatively low order of precision is desired; and even then their use can scarcely be described as satisfactory, or as suited to the needs of the radiologist. The choosing of tubes for such a purpose is not the simple process of asking over the counter for triode amplifiers, but the purchaser must specify what type of triode he desires.

I hope that Dr. Hess will take us into his confidence sufficiently to tell us at least what type of tube he used, the conditions under which he obtained the best results, and the precision he attained. It would be very interesting as well as valuable if he would go so far as to tell us all about his experience with the method, the difficulties encountered, the precautions that must be taken, the number of tubes of the chosen type that must be picked over in order to find two that are sufficiently alike, and so on. A really workable method of the type described is too valuable to be dismissed with such an incomplete report as the one he has already given us, no matter how modest the writer may be.

[1] RADIOLOGY, *2:* 100, Feb., 1924.
[2] *Nature, 108:* 532, 1921.

AMERICAN COLLEGE OF RADIOLOGY

In a recent issue of this Journal the creation and crystallization of the American College of Radiology was announced.

It appears that only recently a somewhat similar society was formed which created some confusion. The purpose of this announcement is to establish the fact that the American College of Radiology is not associated with, or affiliated to, any other organization.

In order that the medical profession and particularly the Radiologists may have the facts, the following statement will be presented as clearly and concisely as brevity will permit. During the June, 1923, session of the American Medical Association at San Francisco, a representative group of America's foremost Radiologists duly assembled

and organized the American College of Radiology. The purpose of this College was to create a Fellowship among medical men, who had distinguished themselves in the science of Radiology, and who would make continued efforts to place the medical and surgical use of X-rays, Radium and allied agents upon the highest possible professional plane commensurate with modern medical and surgical achievements.

It was stipulated that the College should be open to fellowship only by invitation to those members of the regular medical profession, who, in the opinion of the Board of Chancellors of the College, were eligible for fellowship. The American College of Radiology was then duly incorporated in the State of California, and the following officers elected: Geo. E. Pfahler, Philadelphia, President; Henry Schmitz, Chicago, Vice-President; Wm. H. Stewart, New York, President-elect; Albert Soiland, Los Angeles, Executive Secretary; Benj. H. Orndoff, Chicago, Treasurer; I. S. Trostler, Chicago, Historian. The following Chancellors were also elected: Lloyd Bryan, San Francisco; R. D. Carman, Rochester; Edwin C. Ernst, St. Louis; Arial George, Boston; Amédée Granger, New Orleans; Leon T. LeWald, New York; Benj. H. Orndoff, Chicago; G. E. Richards, Toronto; W. W. Wasson, Denver; W. W. Watkins, Phoenix.

The above personnel assures the maintenance of the highest ideals.

The Executive Secretary, Dr. Albert Soiland, invites correspondence relative to the American College of Radiology.

THE AMERICAN MEDICAL ASSOCIATION

Radiology

The American Medical Association has, after mature deliberation, accorded Radiology two sessions in the Section on "Miscellaneous Topics."

This is both a merited and an accredited recognition. It is merited because Radiology has successfully withstood the severest tests of prejudice, ignorance and honest appraisal; because all the sincere and conscientious efforts have been accumulating strength so that the highest tribunal in the medical world has recognized Radiology as an integral part of Medicine and Surgery.

It is an accredited recognition because the American Medical Association is symbolic of all that is fair, honest and worthy. It is the judge of merit, the appraiser of worth, the deterrent of misrepresentation, and the protector of the "Public Health."

In the eternal conflict between truth and ignorance, Radiology can continue to hold up its face to the sun and march westward.

The annual meeting of the American Medical Association will be held in Chicago, June 9 to 13, inclusive. The meeting place will be the Municipal Pier, a large, magnificent building, which extends into Lake Michigan for almost a mile, so that in the hottest days the cool breezes will keep all comfortable.

The sessions on Radiology will be held on the mornings of the twelfth and thirteenth in the Section on "Miscellaneous Topics."

The program is almost complete and promises to be exceedingly interesting.

All Radiologists and those interested in Radiology are asked to attend. Be sure to register in the Section on "Miscellaneous Topics" and specify "Radiology."

The officers appointed by the American Medical Association are Dr. Willis Manges, chairman; Dr. Albert Soiland, vice chairman; Dr. M. J. Hubeny, secretary. These officers earnestly ask your whole-hearted co-operation.

THE NINTH SUMMER MEETING

The Local Committee of Arrangements for the 1924 Summer Meeting of the Radiological Society of North America, to be held at Hotel Sherman, in Chicago, June 6th and 7th next, consists of Drs. M. E. Hanks, B. C. Cushway, M. J. Hubeny, B. H. Orndoff and I. S. Trostler, Chairman.

The Committee is desirous of extending any aid and assistance possible to those who expect to attend. Correspondence should

be addressed to the Chairman, 812 Marshall Field Annex, Chicago.

On account of the numerous meetings to be held at this time, it is advisable for those who expect to attend, to make hotel reservations early. These had best be made with the hotels direct. When writing, be sure to specify clearly the kind of accommodations desired. Chicago has many hotels, varying from the highest class and most expensive, to the more modest and inexpensive.

Those who desire to stay in the downtown or Loop section may find accommodations in the dozen or more large and numerous smaller hotels there to be found. For those who prefer quieter surroundings away from the center of business, good accommodations in either the North or South Sides may be had.

As previously stated, the meeting will be held at Hotel Sherman. This hotel will be headquarters for the radiologists during the meeting of the A. M. A. the week following. A partial list of the principal hotels follows:

DOWNTOWN (LOOP) HOTELS

Hotel and Address	RATES —Without Bath— Single	Double	—With Bath— Single	Double
Atlantic—200 rooms ..... Clark St. near Jackson Blvd.	$2.00 up		$3.00 up	$4.00 up
Auditorium—200 rooms... Mich. Blvd. and Congress St.	3.00 up	4.00 up	4.50 up	6.00 up
Blackstone—300 rooms ... Mich. Blvd. and 7th St.	4.00 up	5.00 up	5.00 up	6.00 up
Brevoort—100 rooms ..... 120 W. Madison St.	2.50 up	4.00 up	3.50 up	4.50 up
Briggs—50 rooms ..... Randolph and Wells Sts.			2.50 up	4.00 up
Congress—200 rooms ..... Mich. Blvd. and Congress St.	3.00 up	5.00 up	5.00 up	7.00 up
Fort Dearborn—200 rooms. LaSalle and VanBuren Sts.	2.50 up	3.50 up	3.00 up	4.00 up
Grant—50 rooms ..... Dearborn and Madison Sts.	1.50 up	3.00 up	2.00 up	4.00 up
Great Northern—200 rooms Jackson, Dearborn and Quincy Sts.	2.50 up	4.00 up	3.50 up	6.00 up
La Salle—400 rooms..... Madison and La Salle Sts.	2.50 up	4.00 up	4.00 up	6.00 up
Lorraine—25 rooms ..... 417 S. Wabash Ave.			2.50 up	3.50 up
Majestic—40 rooms ..... Quincy, bet. State and Dearborn Sts.	2.00 up	3.50 up	2.50 up	5.00 up
Morrison—400 rooms ..... Clark and Madison Sts.	3.00 up	5.00 up	4.00 up	6.00 up
Planters—75 rooms ..... Clark and Madison Sts.	2.50 up	3.50 up	3.00 up	4.00 up
SHERMAN—700 rooms ..	2.50 up	4.50 up	4.00 up	6.00 up

NORTH SIDE HOTELS

Ambassador—100 rooms .. State and Goethe Sts.				3.50 up
Belmont—350 rooms ..... 3160 Sheridan Road			5.00 up	8.00 up
Drake—200 rooms ..... Mich. Av. and Walton Pl.			4.00 up	6.00 up
Edgewater Beach—800 rms. 5300 Sheridan Road			4.00 up	7.00 up
Lott Hotels—400 rooms.. Belden, 2300 Lincoln Pkwy. W. Parkway, 2100 Lincoln Pkwy. W. Webster, Lincoln Pkwy. and Webster Ave.			4.00 up	5.00 up
Melbourne—50 rooms .. 4625 N. Racine Ave.			3.00 up	4.00 up
Pearson—100 rooms ..... E. Pearson St.			6.00 up	7.00 up
Plaza—50 rooms ..... Clark and North Ave.			2.50 up	3.50 up
Plymouth—75 rooms ..... 4700 Broadway	2.00 up	3.00 up	3.00 up	5.00 up
Sheridan-Broadway—300 rms. Sheridan Rd. at Broadway			3.00 up	
Sheridan Plaza—150 rooms Sheridan Rd. at Wilson			3.00 up	4.50 up
Somerset—75 rooms ..... Sheridan Rd. at Argyle			5.00 up	6.00 up
Sovereign—150 rooms .... Kenmore Av. at Granville			4.00 up	
Surf—100 rooms ..... 551 Surf St.			4.00 up	7.00 up
Virginia—50 rooms ..... Cor. Rush and Ohio Sts.			3.00 up	4.00 up

SOUTH SIDE HOTELS

Chicago Beach—250 rooms. Hyde Pk. Blvd. at 51st St.	3.00 up	4.00 up	4.00 up	5.00 up
Cooper-Carlton—100 rooms Hyde Pk. Blvd. at 53d St.			4.00 up	5.00 up
Del Prado—125 rooms..... 59th St. and Blackstone	2.50 up		3.50 up	5.00 up
Drexel Arms—30 rooms... Drexel and Oakwood Blvd.	2.00 up	2.50 up	3.00 up	4.00 up
Hyde Park—75 rooms.... Hyde Park Blvd. and Lake Park Ave.	2.50 up	3.50 up	3.00 up	4.50 up
Lakota—125 rooms ..... Mich. Blvd. at 30th St.			2.00 up	3.00 up
Lexington—200 rooms .... Mich. Blvd. at 22nd St.	2.00 up	3.00 up	3.00 up	4.00 up
Metropole—75 rooms ..... Mich. Blvd. at 23rd St.	2.00 up	3.00 up	3.00 up	4.00 up
New Southern—100 rooms. Mich. Blvd. at 13th St.	2.00 up	3.50 up	3.00 up	5.00 up
Sisson—75 rooms ..... 1725 E. 53rd St.			5.00 up	7.00 up
Windermere—200 rooms .. 1642 E. 56th St.	2.50 up	4.00 up	3.00 up	5.00 up

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The American Radium Society will hold its annual meeting in Chicago on the Monday and Tuesday preceding the American Medical Association meeting in June. Contributions for the program should be forwarded at once to G. E. Pfahler, M.D., 1321 Spruce St., Philadelphia, Pa.

Dr. Wetterer, of Mannheim, Germany, has been chosen by the editor of *Strahlentherapie* to edit a complete special volume, entitled "Radiotherapy in Foreign Countries," in which he hopes to enumerate, not only the contents of all the articles and books which have appeared since 1922, in foreign countries, concerning X-ray and radium treatment, but also to describe the progress of technical science and X-ray apparatus. It is a very great and difficult undertaking, and Dr. Wetterer desires to have the assistance and co-operation of American authors. He will be very glad to receive reprints of articles published and references to all articles.

These references and reprints should be in the hands of Dr. Wetterer at the earliest possible moment.

MID-ANNUAL MEETING

Program Almost Complete for Chicago Meeting Next June

The program for the June meeting of the Radiological Society is now practically complete.

The program is very attractive and we are sure will be much appreciated by the members of the Society. It is hoped that every member will make plans now to attend this meeting, June 6th and 7th, at the Sherman Hotel, Chicago. Remember that a large and interesting program will also be given beginning Monday the week following, so that a full week spent in Chicago at that time will be found very profitable and equivalent to a post-graduate course in radiology. We have a Section in Radiology in the American Medical Association this year, and the American Radium Society holds its meeting the Monday and Tuesday of the following week.

The following is the tentative program:

H. W. Meyerding, Rochester, Minn.—"Radiographical Types of Bone Sarcoma."

Dr. Howard P. Doub and Dr. C. W. Peabody, Ford Hospital, Detroit—Bone Pathology (to be announced late).

Prof. Arthur Compton, Ph.D., University of Chicago—"The Mechanism of Ionization by X-rays."

Dr. Mutscheller, New York—(Title to be announced later.)

Drs. Groover, Christie and Merritt, Washington, D. C.—"Pulmonary Tuberculosis as a Cause of Pain in the Shoulder."

Dr. Henry Schmitz, Chicago—"The Treatment of Surgical Tuberculosis by Quartz Light and X-rays."

Dr. I. Seth Hirsch, New York City—"Cancer of the Lung, a Clinical Roentgen Study."

Dr. Herbert M. Rich, Detroit, Mich.—"Classification in Lung Abscess with Regard to Treatment."

Dr. John D. MacRae, Asheville, N. C.—"Some Aspects of Tuberculosis" (to be announced later).

Dr. L. R. Sante, St. Louis—"X-ray Evidence of Chronic Miliary Tuberculosis."

Prof. C. M. Child, University of Chicago—"Quantitative Factors in the Susceptibility of Living Cells to External Agents."

Dr. H. H. Bowing, Rochester, Minn.—"Significant Cellular Change Observed in Irradiated Tissue, with Special Reference to Rectal Carcinoma."

Dr. Leon J. Menville, New Orleans, La.—"Experimental Work Showing That the Roentgen Rays and Radium Rays do not Kill and Apparently do not Affect the Viability of Tertian Malaria Parasites (Plasmodium Vivax) in Vitro."

Dr. F. P. Boswell, Montgomery, Alabama—"The X-ray Treatment of Acne Vulgaris."

Dr. L. T. LeWald, New York—"Right-sided Diverticulitis."

Dr. W. O. Upson, Battle Creek, Mich.—"Benign Growths of the Stomach."

Dr. Evarts A. Graham, St. Louis, Mo.—"The Roentgenological Visualization of the Gall Bladder by the Use of Intravenous Injections of Calcium Tetrabromphenolphthalein."

Dr. M. J. Sittenfield, New York—"Present Studies in Experimental Cancer."

Dr. Maud Slye, Chicago—Title unannounced.

Dr. Amédée Granger, New Orleans, La.—"New Device and Technic for Making Radiographs of the Mastoids in the Law and Arceline Positions."

Dr. G. F. Thomas, Cleveland, Ohio—"Injuries About the Wrist."

Dr. C. C. Grandy, Fort Wayne, Ind.—"Clinical Roentgenology."

Dr. Byron W. Darling, New York—"The Sacroiliac Joint—Its Diagnosis as Determined by the X-ray."

Dr. K. S. Davis, Rochester, Minn.—To be announced later.

Dr. C. D. Enfield, Louisville, Ky.—To be announced later.

Dr. R. D. Carman, Rochester, Minn.—To be announced later.

Dr. B. H. Orndoff, Chicago, Ill.—To be announced later.

Dr. W. L. Clark, Philadelphia, Pa.—To be announced later.

Dr. John Murphy, Toledo, O.—To be announced later.

The death of Dr. Ralph Walter Mills, of St. Louis, was recorded in last month's issue of this journal, and a sketch of his life and accomplishments is being prepared by members of the Radiological Society who knew him well, for publication in the May number of Radiology. A fine portrait of Dr. Mills has been secured from his family, and will accompany the sketch.

BOOK REVIEWS

TRAITADO SORRE RADIOTERAPIA SUPERFICIAL Y PROFONDA. POR EL DR. CARLOS HEUSER, ex-jefe-del Servicio de Electrotherapia del Hospital N. de A., etc. 1924, "La Semana Medica," Imprenta de E. Spigelli, 2254 Cordoba, Buenos Aires, Argentina. Pp. 407.

In this book, the text paper, illustrations and print are of excellent quality. Approximately a hundred pages are devoted to a description of roentgen apparatus, filters, technic and mathematical formulæ for dosage. Dr. Heuser describes various types of American, German, French and English installations, with all of which he shows familiarity. To these he has added his own modifications, which seem to be in step with recent progress. For a deep dose with a well-known American transformer, his formula is 200 KV., 5 ma., 50 cm. skin-focus distance, 1 mm. copper filter; 400 milliampere minutes being required.

The author recognizes four distinct grades of radiodermatitis with a latent period of from two to twenty-five days. In the first grade there is a mild inflammation of the skin with redness and exfoliation, resorption of small tumors, such as small cysts, etc. Grade 2 is characterized by a hyperemic, erythematous dermatitis, with swelling and sharp pains which disappear in three to six weeks. In Grade 3 there is exudation, excoriation, epilation, destruction of sudorific and sebaceous glands, neuritis with severe pain, subsequent atrophy or scarring, and, in some cases, necrotic ulcers. Grade 4 is a gangrenous dermatitis.

Present day tendency is toward the single full dose, but in some cases, such as eczema, fractional doses are preferable. Because of the cumulative effect, which may occur as late as six months afterward, fractional dosage has its hazards.

Superficial radiotherapy has its application in various skin diseases. Four classes of cases may be recognized: 1. The acnes and eczemas, in which the rays operate by irritation. 2. Papular, vegetal dermatoses, keratoses, neurodermatoses, infection of the skin, in which the radiologic action is sclerosal. 3. Tumors of the skin, action being sclerosal. 4. Newgrowths proper, in which the rays produce destruction.

In actinomycosis, the X-ray should be used in conjunction with medical treatment (iodine intravenously). Improvement is brought about by the atrophying effect and not by destruction of the actinomyces.

In cancer of the skin, the author prefers the single destructive dose. For cancer of the breast, he advises pre-operative therapy. In bronchial asthma, he states that an irritative local dose will effect cure.

When symptoms recur after gastroenterostomy, the author asserts that deep radiotherapy is indicated. In cases of acute gastric ulcer with persistent hemorrhage, radiotherapy should be used to increase the coagulability of the blood, but he excludes cases with hourglass stomach or pyloric obstruction. Radiation is indicated in ulcer cases in which there are neurasthenic manifestations with alternations of symptoms and relief. In treating gastric ulcer, the site of the ulcer should be determined and a single, deep, full dose should be given, but no results will be obtained unless the usual medical measures are also carried out. Dr. Heuser cites Schulze and Berge as having published accounts of fifty-two cases of ulcer of the stomach, which improved rapidly after radiotherapy.

In myelogenous leukemia only the spleen and liver are treated, while in lymphatic leukemia all the glands should be irradiated. Large mediastinal glands disappear after a single application. Lymphosarcoma of the mediastinum is less radio-sensitive. The swollen spleen of myelogenous leukemia diminishes rapidly after full therapy, but if fractional doses are given, the tumor is likely to increase rapidly and the patient dies. On the other hand, in lymphatic leu-

kemia, the gland tumors quickly diminish and the patient recovers.

For fibroma of the uterus, if clinical examination is thorough and operation can be performed easily, extirpation is preferable to radiotherapy, otherwise the latter is to be chosen. The author naively adds that often sarcoma or ovarian tumor is mistaken for fibroma.

Cancer of the cervix is much more malignant than cancer of the fundus. The author urges both pre-operative and post-operative therapy in full dose.

Treatment of many other conditions is described and the book ends with a short chapter on radium therapy. The author's enthusiasm and confidence in radiotherapy are apparent throughout the book.

For translation of the foregoing excerpts, the reviewer is indebted to Miss Hattie Finley, Editorial Department, Mayo Clinic.

R. D. CARMAN, M.D.

PHYSIOTHERAPY TECHNIC. A Manual of Applied Physics. By C. M. SAMPSON, M.D. 443 pages, 85 illustrations. Published by C. V. Mosby Co., St. Louis, 1923. Cloth, $6.50.

The general make-up of the book is above the average.

In the introduction, Dr. Sampson gives what seems to be the keynote of the physiotherapist. He dedicates the book to *therapeutic "peptimists,"* and describes a "peptimist" as an optimistic visionary who tries to make his visions come true. The author is evidently a *therapeutic peptimist.*

Although the author becomes rather verbose in regard to some of the subjects, and the text is unnecessarily expanded by superfluous instructions regarding the examination of patients (physicians know and do this, and technicians have no business doing it), personal anecdotes, examples, and accounts of differences with other physicians, etc., the *tout ensemble* of the text is instructive and of distinct value.

The explanation of high frequency electricity is unusually good, as is also the technic. The omission of instructions for use of the vacuum tube is admirable.

The chapters on diathermia and autocondensation are excellent, and furnish a rather complete treatise on these subjects.

Actinotherapy is exhaustively treated and thoroughly discussed. While it is the reviewer's opinion that too much is claimed for actinotherapy, the text of this author is the best we have read. This is especially true in regard to ultraviolet rays.

The section on X-ray therapy is replete with statements and claims that are too radical and smack too much of the early extravagant claims made for roentgenotherapy. This is particularly true in regard to stimulating dosage, which careful observers seriously question, and several capable experimenters have disproven.

The chapter on "X-ray 'Burns'" emphasizes the value of actinotherapy in this condition.

The chapter on "Galvanic and Faradic Currents" and on the "Sinusoidal Current" are good, concise discussions of these useful modalities. Massage and Hydrotherapy are well handled.

Chapter XXV, on "Trouble Shooting," is excellent, and unique in being the first and only complete chapter on this subject ever included in any book on technic.

While the reviewer believes that physiotherapy is being badly overdone (too much *peptimism*), he thinks it is well to have some such text as Sampson's at hand. The book is valuable in a general way.

I. S. T.

ABSTRACTS OF CURRENT LITERATURE

Accessory sinus disease.—Divergent opinions are expressed by medical authorities relative to the value of radiographic examinations in accessory sinus disease. The present article is intended to clarify some of the obscure points of diagnosis and also to analyze some of the sources of error. The radiographic interpretation is often criticized without a real appreciation of the technical difficulties encountered in the laboratory, and often the clinician will ask for reports that are absurd.

A thorough physical examination is important in order to rule out extra-sinusal conditions that simulate true sinus disease, e.g., indefinite facial pain, neuralgias, headaches, errors of refraction, as well as focal infection in diseased teeth, tonsils, gum abscesses, intra-nasal conditions such as deviated septa, enlarged turbinates, etc.

The comparison between transillumination with radiographic diagnosis is often made and not always fairly so, for limitations are met with in both, as well as points of advantage, and the better procedure is to use both.

A true appreciation of the normal is necessary, as well as the variations within the normal. The frontal sinuses are often absent, and, when present, vary greatly in size, shape, and depth, and here transillumination as a guide is worthless, while in the antra its use has a definite value.

Radiographic error is often due to imperfect appreciation of the various shades of density which pathological sinuses will produce, e.g., a small thick sinus of the average depth will often appear as pus or granulations when neither exists, whereas a large, thin-walled sinus of greater depth may appear normal and yet contain pus or granulations. The reason for this is apparent, for in the small, thick sinus there is little air space and it is consequently more difficult of penetration, and this may be variously interpreted. Again, in the case of the large, thin-walled sinus the penetration may obliterate finer shadows indicative of pathology. Further, in a small thick sinus the exudate of an acute sinusitis may not add to the density, and hence be overlooked. This is true both of radiographic and transilluminating measures. It is this acuteness in differentiation of the finer shadow densities that reduce the percentage of error.

Mistaking an absent sinus for one containing pus or granulations is rare, as there is always a limiting border in a frontal sinus, no matter how much pus may be contained in it.

Failure to report conditions of the ethmoidal cells in the frontal region is often noted, but this is important as these are often infected and symptoms produced are identical with true sinus disease.

The sphenoidal sinuses are more often infected than is commonly supposed, and to show this area a lateral view alone is not sufficient. The Pfahler technic is as follows:

A 2-inch by 3-inch film between intensifying screens is placed in the mouth and the exposure is made through the vertex. This gives a clear picture of the sphenoids in which the right and left can be differentiated, and it also gives a horizontal exposure of the ethmoidal cells.

In the maxillary antra a common source of error is the position in which the exposure is made. The usual postero-anterior view usually suffices to project the petrous portion of the temporal bones into the lower half of the orbit, out of the maxillary area, but faulty technic will cast shadows of these bones over the antra. The Walters-Waldron position, with chin on the plate and exposure through the vertex, is recommended for routine work; it also shows frontal sinuses exceptionally well.

It is impossible to differentiate pus from granulations in the antra. Various media have been injected into the antra for this purpose but no working formula has yet been devised.

C. A. HYER, M.D.

Accessory Sinusitis. M. M. Pomeranz. Med. Jour. and Record (Resp. Supp., VII), CXIX, Feb. 6, 1924.

Echinococcus cyst.—The author reports the case of a female, age 30, complaining of dull constant pain in right abdomen, with nausea, belching and vomiting after meals. Examination revealed a mass in the right hypochondrium below the costal margin, which was smooth, tender and moved on respiration; otherwise the examination was negative.

Diagnosis: Hydrops of the gall bladder.

X-ray examination of the gastro-intestinal tract was negative. Examination of the gall bladder revealed a sharply circumscribed, smooth mass in the right hypochondrium, extending 3 inches below the liver margin, of the same density as liver substance, and covering the kidney. A diagnosis of cyst of the liver was made.

At operation a large soft gray cyst, the size of a grape fruit, was found attached to the liver, and containing grayish fluid, with daughter and granddaughter cysts. The cyst was drained and packed with gauze. Small fat granules in the cyst wall proved to be calyces and under the microscope proved to represent 4 sucking discs

and a circle of hooklets. Another cyst was found in the left lobe of the liver, but was not removed.

Patient died seven days later and autopsy showed three cysts of the liver involving one-third of the liver tissue. The lung showed two cysts in the right lower lobe and one cyst in the left upper lobe similar to those of the liver and composing about two-thirds of the pulmonic field.

No X-rays of the chest were made, but with the X-ray findings of the liver, and later operative findings, echinococcus cyst would have been a logical diagnosis, although there was no clinical history of pulmonary involvement.

C. A. HYER, M.D.

Radiological Findings in a Case of Echinococcus Cyst of the Lung and the Liver. I. Glassman. Med. Jour. and Record, CXIX, Feb. 6, 1924.

Uterine fibromyomata.—Béclère says that in 700 cases of uterine myomata submitted to roentgenotherapy, 7 times only, despite the suppression of ovarian activity obtained by this treatment, the persistence of metrorrhagia necessitated a surgical operation, a hysterectomy which showed with the absence of any epitheliomatous lesion of the intra-uterine mucosa that a submucous myoma was the cause of the persistent hemorrhage.

It cannot be argued from such exceptional facts that the submucous myomata are refractory to roentgenotherapy, and that consequently the submucous situation of myomata is a contra-indication of the employment of roentgen rays. Béclère has collected a great number of cases in which the form of the uterine tumor and the abundance and continuity of the metrorrhagia allowed no doubt of the existence of a submucous myoma and in which the roentgen treatment nevertheless had its customary success. The only conclusion permissible is that these exceptional cases of failure of the roentgen treatment appear to be exclusively cases of submucous myoma and necessitate surgical treatment.—*Are there Fibromyomata of the Uterus Refractory to Roentgenotherapy? (Existe-t-il des fibro-myomes de l'utérus réfractaires à la roentgenothérapie?) H. Béclère. Jour. de Radiol. et d'Electrothérapie, 1922, VI, 471.*

Post-menopausal myomata.—Gynecologists generally admit that there is an involution of fibromyomata after the menopause and recommend that in the case of myomata neither very voluminous nor hemorrhagic the menopause should be awaited, after which they ought to disappear. But there are fibromyomata of the uterus which continue to develop after the menopause and which the author designates under the name of post-menopausal myomata. Such myomata are perfectly amenable to radiotherapy and the results obtained are remarkable. The diminution and in some cases the disappearance of post-menopausal fibromyomata give proof of a direct cyto-caustic action of the X-rays on the myomatous cells. Of eight cases which the author has observed and treated during the past two years, in six there was a remarkable diminution of the fibroma, this amounting to almost complete disappearance in three cases.

Seitz and Wintz considered that the rapid diminution of a uterine tumor (diminution of myomata according to these authors not commencing until four or five months after irradiation) under the action of roentgen rays and post-menopausal development of the uterine tumor was an indication for the diagnosis of sarcoma or of a myoma in the process of sarcomatous degeneration. The rapid regression of a uterine tumor under the influence of the roentgen rays, according to Seitz and Wintz, was the basis of differential diagnosis between sarcoma and myoma of the uterus. The examination of the cases treated by Solomon does not confirm this opinion of Seitz and Wintz. The facts that the myoma existed a long time, that its increase was relatively slow and that it did not increase more rapidly after the menopause, the absence of metastases, and the persistence of recovery in spite of the employment of relatively small fractional doses of rays give certainty that it was a matter of myoma and not of sarcoma.

Raidotherapy of post-menopausal uterine fibromyomata gives an irrefutable demonstration of the direct action of roentgen radiation on the myomatous tissue. In fact the menopause having suppressed the ovarian factor, the diminution and in certain cases disappearance of myomata which continue to develop can only be due to a direct action of the rays on the myomatous tissue.—*Radiotherapy of Post-menopausal Fibromyomata (Radiothérapie des fibro-myomes post-ménopausiques). I. Solomon. Jour. de Radiol. et d'Électrothérapie, 1922, VI, 468.*

Radiotherapy for cervical cancer.—At Nuernberg Clinic during the past ten years Flatau has treated 310 cases of uterine cervical cancer by radiotherapy. Of these patients 24 per cent are still living, the others having either died or been lost sight of.

Of the 310 cases 101 were operable, the disease being confined to the cervix without any involvement of the glands being revealed; 209 cases were deemed inoperable. Of the operable cases 50 per cent and of the inoperable cases 9.5 per cent are still alive. Most of the inoper-

able cases were improved and the inoperable 9.5 per cent cured could have been cured in no other way. Sixty-eight cases have been treated during the past 3 years as follows: 50 mg. of radium is placed in the cervical canal for 48 hours and 50 mg. placed against the growth in the vagina for 24 hours; and, with the radium application, cross irradiation of the pelvis from back to front and from side to side is combined. Twenty-two of these cases were operable and 46 inoperable. Of the operable cases 80 per cent and of the inoperable cases 22 per cent are still alive and well.

The author thinks that his results compare very favorably with other results both operative and radiotherapeutic, as with other treatments recurrences even during the first year after treatment are extremely frequent.

Flatau strongly recommends radiotherapy for cervical cancer. He thinks it is a safe method of treatment with no immediate mortality and with the improved technic fistulæ, burns, or skin troubles are being eliminated. In cancer of the cervix radiotherapy effects successes which surgery could never obtain.—*Radiotherapy of Carcinoma of Uterine Cervix (Ergebnisse der Strahlenbehandlung des Gebaermutterkrebses). W. S. Flatau. Zentralbl. f. Gynaek., 1923, XLVII, 737.*

Chemistry of the blood after radiation.—The authors have studied the effects on the blood of repeated exposures of cancerous tumors to X-rays. After five or six applications of doses of from 5 to 10 H units there was an increase of from 4 to 12 per cent of albumen in the blood serum, probably due to increase of globulin; an increase of from 0.06 to 0.18 in amino-acid content of the serum; an increase in total lipoids of the serum; and a large increase in the sugar content of the serum.

The changes, the authors think, are due to the fact that repeated doses of X-rays disintegrate the cells of cancerous tumors and liberate quantities of globulins, amino-acids, sugar and lipoids, which pass into the blood stream and cause the changes observed.—*Variations in the Chemistry of the Blood Following Radiation of Tumors. M. Loeper and J. Tonnet. Bull. assoc. franç. pour l'étude du cancer. Feb., 1923.*

Treatment of thymic enlargement.—Thymic enlargement is receiving more attention. Roentgen ray is undoubtedly the most reliable means of diagnosis, and radiation by X-ray or radium is a specific in treatment. So general is the response that if the condition present does not show rapid relief after a few X-ray treatments, the conclusion is that the diagnosis is probably wrong. The thymus may be enlarged without symptoms and thymic symptoms may develop when there is no evidence in the roentgenogram of an enlarged thymus. By the X-ray we can show only lateral enlargement, while the antero-posterior enlargement is the type which causes dyspnea. The therapeutic test is often of more value than the radiograph.

TECHNIC OF X-RAY TREATMENT

The child is wrapped in a turkish towel and pinned tightly. The author uses a 9-inch spark gap, 5 ma. at a focal skin distance of 30 cm., for 15 or 20 minutes, with rays filtered through 6 millimeters of aluminum. The rays are focused directly upon the thymic area by means of a 3-inch cylinder.

Where time is the most important factor one may use 9-inch spark gap, 5 ma., 3 mm. aluminum filter, 10-inch distance, 3 minutes' exposure for newborns and 5 minutes for older children.

It is the author's practice to treat patients once in four weeks, and three to five treatments should be sufficient. If more than five to eight such treatments are needed, the condition is almost certainly not due to enlarged thymus. He has seen striking improvement within forty-eight hours.

RADIUM THERAPY—ADVANTAGES OF RADIUM

1. It can be applied without any annoyance or struggle on the part of the child.
2. Radiation can be kept definitely in place.
3. Action of radium is more rapid and usually one application is sufficient.
4. Radium is portable and makes treatment possible at the patient's home.

TECHNIC OF RADIUM TREATMENT

One hundred milligrams with 0.5 silver for filter wrapped in gauze, so that when strapped to the chest it will be ½ inch from the surface. Four marks are made in a rectangle over the thymic area and the package of radium remains for two hours over each area, amounting to a total exposure of 800 milligram hours.

L. R. SANTE, M.D.

The Diagnosis of Enlarged Thymus by the X-ray and Treatment by X-ray or Radium. G. E. Pfahler. Archives of Pediatrics, XLI, No. 1, Jan., 1924, 39.

Roentgen-ray examination of the chest.—Several observers have emphasized the oblique projection of the chest. The writer feels that this is of value in many cases but questions its applicability to the exact localization of foreign bodies, lung abscesses, etc. Two roentgenograms, one antero-posterior and one exact lateral, serve better for localization than stereo-

scopic antero-posterior plates. In the localization of lung abscess this is found to be applicable. If a two-stage operation is done, iodoform gauze packed in the wound at the site of the first stage will give a guide to the second stage of the operation and will show in what direction and how far the abscess is from the gauze. It is also of great value in the localization of encysted collections of pus between the layers of pleura—either parietal and visceral or between the lobes.

It is of value in certain rare lesions such as congenital and acquired hernia of the diaphragm, in thoracic stomach and in eventration of the diaphragm. In localization of foreign bodies it is also very desirable. Seven case reports are cited, and many cuts illustrate the value of the method.

L. R. SANTE, M.D.

Value of the Lateral Projection in the Roentgen-ray Examination of the Chest, with Special Reference to the Surgical Treatment of Abscess of the Lung. Leon T. LeWald and Nathan W. Green. Archives of Surgery, VIII, No. 1, Part 2, Jan., 1924, 265.

Diagnosis of hydronephrosis.—Nichols in the study of a series of cases of hydronephrosis found that in 30 per cent a previous operation had been performed for cholelithiasis or appendicitis without subsequent relief of the symptoms. This simulation of the symptoms indicates the importance of pyelography in differential diagnosis.

Thorough knowledge of the normal renal pelvis and its normal variants as shadowed in the pyelogram is, of course, essential. In different individuals the pelvis may vary greatly in shape and size. It may be comparatively spherical, square, long or tubular. The major calyces may unite and form its greater portion, or they may be practically absent, so that the pelvis leads directly into the minor calyces. Further, the major calyces may assume a variety of shapes and sizes, and any one of them may be longer than its fellows; while there are usually three on each side there may be four, or only two. In most individuals the capacity of the pelvis is the same on both sides, but occasionally one is larger than the other. The minor calyces also vary in contour as seen by the X-ray.

Technical details of the examination must be properly carried out. If possible, all residual urine must be drained out from the pelvis and calyces. There should be no movement of the patient during exposure of the films. The films should show the minor calyces distinctly. An injection to be of diagnostic value must be continued until the patient experiences a sense of pain, indicating that a sufficient quantity has been given.

The first indication of a beginning hydronephrosis is often difficult to determine. If the kidney pelvis has a capacity of 20 to 25 c.c. of solution, there is usually a hydronephrosis, but some normal pelves may have this capacity. The first pyelographic evidence of hydronephrotic changes is a dimness of outline and inflation of the minor calyces, which should appear in more than one calyx. Next may be seen a widening of the bases of the major calyces, giving the so-called "plug-hat calyx" of Keyes. Then follows enlargement of the renal pelvis. As pressure continues the major calyces widen throughout, the minor calyces disappear, the angle formed by the ureter at its entrance into the renal pelvis becomes more acute, and the pelvis more dilated. Comparison of the two kidneys is sometimes necessary.

In an advanced case there will be extensive dilatation of the pelvis, rounded individual areas and dim areas suggesting fluid; the major calyces will not only be broadened, but shortened so that they make only a shallow indentation into the hydronephrotic sac.—*Hydronephrosis. B. H. Nichols. Am. Jour. Roentgenol., XI, Jan., 1924, 25.*

Symptoms and treatment of primary carcinoma of the lung.—Since Bayle's report of primary carcinoma of the lung nearly a century ago, many cases have been added. Adler collected from the literature up to 1912, 374 cases of primary malignant newgrowths of the lungs and bronchi, and many additional cases have been reported since.

The etiology of primary carcinoma of the lung remains as obscure as carcinoma elsewhere, although there is an apparent increase of frequency since the pandemic of influenza in 1918-19, as observed by several writers. The symptoms are often similar to the other, and more common, pulmonary diseases, and while the diagnosis of this infrequent condition in its classical form may not be difficult, yet we see many cases reported not diagnosed or incorrectly so, prior to autopsy. Only three cases have been reported in England since 1918, while in America more than thirty have been recorded by Carman, McMahon, Barron and others. This disparity is thought due to the lack of routine autopsy and to infirmary reports not being investigated.

These authors cite 4 established cases taken from 3,183 postmortem examinations, and 2 additional cases were not included, in which diagnosis was not confirmed by autopsy.

Tuberculosis and pneumonoconiosis were not present in these 4 cases, but chronic bronchitis was present in 2, being associated with asthma of 8 years' duration in one of these, while in the other 2 cases influenza directly preceded the admission of the patient in one, and the other had had it 25 years previous to the present illness.

It is not improbable that chronic inflammatory changes in the bronchial mucosa provide an antecedent factor, and influenza can be one of these conditions that can result in chronic bronchitis.

Ewing states there are three types of pulmonary carcinomata histologically distinguishable according to their origin in (a) bronchial epithelium, (b) bronchial mucous glands, or (c) alveolar epithelium.

In diagnosis it must be remembered that the condition is infrequent and in comparison to tuberculosis is rare, hence it is not suspected in a great majority of cases.

Difficulty of breathing is probably the first symptom, accompanied by a cough of non-productive nature. Pain usually is present later as the pleura becomes involved, either dull aching or sharp and stabbing, and extremely constant. Prune-juice sputum is rarely present and then only late; hemorrhage is not infrequent; absence of tubercle bacilli is suggestive, and degenerated carcinoma cells, if found, are conclusive; but sputum examinations are often misleading, as bronchiectatic, tuberculous, or pneumonic sputum may be present, depending on the actual pulmonary conditions, for bronchial obstruction with bronchiectasis, pleural effusion, and abscess formation are all confusing to interpret.

Physical signs include impaired mobility of the affected side, dullness to flatness in percussion, and diminished vocal fremitus. These are all characteristic of lung collapse consequent to bronchial obstruction, and not of the tumor mass itself.

X-ray evidence is variable, due often to extensive fibrosis of the lungs and pleura, with pleural adhesions or effusion, and these may mask the picture, depending on variations in the density of the lung substance.

Bronchoscopy is of value only if the tumor originates in the main bronchus. Lung puncture may have dangers that outweigh the possible advantages of obtaining carcinomatous debris.

Treatment of these cases is unsatisfactory. Surgery offers little. Lenhartz successfully operated on one case and practically the whole lung was excised. Morriston Davis reports another successful case.

Ninety per cent of the primary carcinomata start near the root of the lung and metastasize early, which almost eliminates surgical intervention.

Radiation therapy would seem the next logical step, but here statistics are not available, probably because the disease is far advanced and only a few months of life remain when a diagnosis of a primary neoplasm is justified.

In all those cases the duration of symptoms to death was only 3 months in two, 9 months in another, and in the fourth case an indefinite asthmatic history of 8 years. Complications are varied and numerous, such as hemorrhage, septicemia, tuberculosis, effusion and empyema, while direct invasion gives many pressure effects on vessels and nerves.

Metastases have been found in all structures of the body, and nothing distinctive is associated with the different histological types.

The authors give in detail full reports of four cases with autopsy findings and histological studies.

C. A. HYER, M.D.

Primary Carcinoma of Lung. K. Playfair and C. P. G. Wakeley. Brit. Jour. Surg., XI, Oct., 1923, 203.

Mono-osteitic type of Paget's disease.—In 1876, Sir James Paget reported this strange affection of bone which bears his name, and many cases have been reported since. The percentage of reports in which a single bone was involved comprise a very small percentage of the total number reported. The first reliable report of the mono-osteitic form was made by Sir Anthony Bowlby in 1883. Three cases are cited in detail and illustrated.

SUMMARY

Paget's disease of bone (osteitis deformans), an unmistakable disorder in its outspoken form, is nevertheless a rare disease. The so-called mono-osteitic type is still more uncommon. When, however, it appears, it presents in a single bone exactly the same clinical picture and roentgenographic findings which are present in the generalized form. While it seems possible adequately to differentiate this type from other single bone lesions, until more information is forthcoming we must content ourselves with the view that these cases are possibly nothing more than a localized expression of the better known, more generalized disease.

L. R. SANTE, M.D.

The Mono-osteitic Type of Paget's Disease of Bone (Osteitis deformans). Francis C. Newton. Archives of Surgery, VIII, No. 1, Part 1, Jan., 1924, 24.

Skin diseases.—After a general review of the subject, the author states that, in his opinion, the roentgen ray is the most important single agent that we possess at the present time in the treatment of skin diseases. Its great versatility is shown by its ability to benefit inflammatory diseases, infectious granulomata and neoplasms. One of the most striking results to be obtained is to be seen in favus and ringworm of the scalp, where its action is due to its epilating effect. In checking mycosis fungoides, the X-ray or radium holds a unique place. In acne vulgaris, eczema and lichen planus, it is the most useful local remedy. In selected cases of psoriasis it is of great service. In various infectious granulomata, basal cell epithelioma, certain verrucous conditions, keloid, localized pruritus and hyperhidrosis, its value is beyond question. It is hardly necessary to add that the roentgen ray should be used only by those who thoroughly understand its action, have sufficient training and are careful to keep their apparatus in perfect working order.

Radium has a much more restricted field, due to the limited area over which it can be used, as well as the time involved for its application. Where it can be applied, it will probably accomplish all that the X-ray will.

W. W. WATKINS, M.D.

Modern Dermatologic Therapy. Howard Fox. Southern Med. Jour., XVII, Jan., 1924.

Gall-bladder disease.—The right part of the abdomen, especially the upper right quadrant, is the site of the most perplexing problems with which the physician has to deal. Here lie, from above downward, the pylorus, the duodenum, the gall bladder, the right kidney, the appendix, and the right ovary and tube in the female. The point that people do not get sick according to text-books, there being myriad variations, is emphasized. A systematic differential diagnosis is considered and applied to a hypothetical case. The stomach, gall bladder, right kidney, appendix and right tube and ovary are considered, each having its characteristic symptoms pointed out. As a rule, one cannot differentiate between perforation of the stomach and gall bladder unless the previous condition of the patient is known. The two conditions to bear in mind when thinking of the acute diseases of the gall bladder are inflammation of the gall bladder and stones in the gall bladder. Palpation should always be used in examining the kidney. One should be over-careful in diagnosing appendicitis in the absence of nausea and vomiting. A careful vaginal examination should be made in regard to inflammation of the ovary and tube.

A differential white blood count and microscopic examination of the urine are two invaluable aids and can be done so quickly that they should be in reach of all. X-ray would not be resorted to in acute cases, but it is invaluable in chronic or interval cases. In skilled hands about 80 per cent of ulcer cases can be demonstrated by it. A negative X-ray for gallstones means nothing, for shadows are found in a very small proportion of cases when stones of even considerable size exist.

In all cases great care should be used in getting an accurate history, and nothing so conduces to accuracy as writing the history down.

People with gallstones often have eliminated one article of diet after another until they scarcely have enough to sustain them. Ulcer people will usually tell us that food relieves their pain, or that the pain is worse just before meals when the stomach is empty. This relation to eating gives the clew.

One should always avoid the use of purgatives. Empty both ends of the gastro-intestinal tract by stomach-tube and enema, and splint the middle segment, using small doses of morphine.

After the abdomen is opened the surgeon should always decide then which way to proceed, for to act upon a predetermined plan is often unwise. It is stated that if there is profuse capillary hemorrhage when adhesions are separated, one should drain and quit; and be no more ashamed of it than of the first step in a two-stage prostatectomy.

W. J. MARQUIS, M.D.

Some Practical Points in the Diagnosis and Treatment of Gall-bladder Disease. W. L. Peple. Va. Med. Monthly, L, Jan., 1924, 692.

Pulmonary tuberculosis. — Clinicians and roentgenologists must realize that the roentgenogram supplies only a silhouette of the pathologic process, and it is, therefore, imperative that the shadow be properly interpreted. The author discusses the following types:

Primary Tubercle: The healed primary tubercle is seen with surprising frequency in radiographs of the adult chest. It is usually single, occasionally multiple. When single, it is represented by a sharply circumscribed spot, varying in size from a pin-head to that of a hazelnut, situated usually in the peripheral portion of the lower lung field. It frequently occurs below the level of the dome of the diaphragm and may be invisible on the radiograph, but visible fluoroscopically on rotation of the patient under the screen.

Adult Type of Tuberculosis: This form begins by gradual extension from the hilum upward and outward along the peribronchial lymphatic paths to the uppermost portion of the lung on one or both sides. The lesions are character-

ized by a caseation process with more or less tendency to fibrous tissue proliferation.

Chronic Fibrocaseous Tuberculosis: This most frequent form is characterized on the radiograph by patch-like spots with indefinite irregular borders, representing the freshly caseated areas. There will also be found band or line-like shadows radiating outward and upward from the hilum and these shadows have sharply circumscribed borders; the more sharply circumscribed, the older and less active the disease.

Chronic Quiescent Fibrocaseous Tuberculosis: The shadows characteristic of this type are as a rule sharply defined and linear. Embedded in these opaque areas one often sees the central clear spots representing cavities.

Early Diagnosis of Tuberculosis: One may see a very delicate fan-shaped area of decreased opacity, extending from the hilum to the apex or to the upper lateral lung field. The shadows are linear, more or less beaded or varicose, and present fuzzy or circumscribed borders, depending upon the activity or inactivity and age of the lesions.

Peribronchial Infiltration: The deep peribronchial types of infiltration, when tuberculous, usually present a beaded varicose appearance with more or less sharply defined borders, and this network of shadows may be traceable to the peripheral parts. Somewhat similar changes are found in the post-influenzal chest, or even after pneumonia, but in the tuberculous infiltrations the shadows are more clearly defined, present a more beaded appearance, show a tendency to involve the upper half of the lung and are persistent for months or years.

Tuberculous and Non-Tuberculous Bronchitis: Ordinary bronchitis produces few, if any, roentgenologic changes, but in the tuberculous forms we find the bronchial tree in the affected area greatly thickened, presenting an irregular or beaded appearance. The shadows are more sharply defined in chronic types and less clearly shown in acute varieties.

Acute Types of Tuberculosis: It must be realized that the small speck-like spots which represent miliary tubercles are not present until the disease is quite advanced, and then appear as fine specks with a hazy border. On good plates one is able to see a very fine thread-like network of the lymphatics of the lungs, and the tubercles will be found along and embedded in this network, giving it a beaded appearance. Mineral deposits in the lung give sharply circumscribed spots usually much larger than the miliary tubercle.

Pleuritic Exudates: The X-ray permits us to view, even through an exudate, changes in the lung parenchyma. Evidences of a former tuberculosis infection in the lung parenchyma or peribronchial structures aid in the diagnosis of exudate due to tuberculosis infection.

T. S. SWAN, M.D.

The Use of the X-ray in the Diagnosis of Pulmonary Tuberculosis. Ray W. Matson. Northwest Medicine, XXIII, Jan., 1924, p. 9.

Disease of the bones.—The vascular supply of the bones is reviewed, with emphasis on the main nutrient artery, which enters the shaft of long bones and divides to supply the entire shaft, ending in fine capillaries at the metaphyses. It is in these terminal branches that septic infarcts lodge, producing an acute hematogenous osteomyelitis. The infarcts may have their origin in any one of numerous foci, such as a furuncle, or an infected tonsillar crypt. The rigidity of the bone structure will not permit swelling, and necrosis occurs early, extending along the marrow, or through the cortex, where it may extend beneath the periosteum, causing a necrosis of the entire shaft. The organism usually found is staphylococcus aureus.

The clinical picture presents a typical onset in most cases—exposure, or a minor infection, or trauma, followed in a few days by an acute persistent pain near a joint, with marked septic symptoms. A primary joint lesion must be ruled out. The X-ray examination is valueless, for the bone changes are not sufficient, early in the disease, to be shown radiographically. Operation should not be delayed until a positive roentgen diagnosis can be made, for only by early surgical treatment can permanent injury to the bone be prevented.

D. B. HARDING, M.D.

Osteomyelitis. Urban Maes. New Orleans Med. and Surg. Jour., LXXVI, Feb., 1924, p. 365.

Therapeutic application of X-rays.—Extensive study and experimentation have established certain laws and facts upon which the present-day therapeutic application of X-rays is based. The development of accurate measuring instruments, and facts determined by their use, have been most important in deciding the success of high voltage therapy. It is generally admitted that the biological action of roentgen rays of different wave lengths is identical, and that only a small part of this action is due directly to the primary beam, the greater part being a result of the secondary and scattered radiation produced by it. Surface lesions will respond as readily to low voltage therapy as to the high. The great advantage of the latter lies in the possibility of delivering an accurately determined

and effective dose to deep-seated lesions without injuring the superficial tissues. Although the susceptibility of neoplasms varies greatly, 110 per cent of the maximum dose tolerated by the skin will control the growth of most malignant tumors, and sometimes produce a complete disappearance of the local lesion. In treating the lesions, the ports of entry should be as small as possible, and placed so that the part to be treated will be directly in the path of the central beam. Radium cannot be used in conjunction with X-rays, because the intensity of the radium radiation decreases so rapidly with distance from the source, that uniform intensity cannot possibly be obtained. In small, well localized malignant lesions, radium or surgery is indicated, but in all others, roentgen radiation is the choice.

D. B. HARDING, M.D.

Practical Application of High Voltage X-rays. S. C. Barrow. New Orleans Med. and Surg. Jour., LXXVI, Feb., 1924, p. 379.

Intestinal lesions. — Among the congenital deformities of the colon, the most striking is the extremely dilated colon seen in Hirschsprung's disease, the dilatation seeming to be due to congenital changes in the walls, or to deficient innervation, as peristalsis is entirely absent. Children showing this condition are usually poor operative risks, requiring a two-stage operation. In adults, operation, with its necessary risk, may not be advisable.

Intestinal stasis, with so-called auto-intoxication, formerly supposed to be the cause of many forms of disease, has almost ceased to have surgical consideration. Surgical procedure based on a change in physiologic processes has not been successful, and only in cases showing local inflammatory changes will operation prove satisfactory.

Chronic ulcerative colitis presents several difficulties in surgical treatment. The same streptococci which are at least partly responsible for the lesion, apparently exist in all the tissues, and a general infection may result from the least manipulation of the colon. The immediate results of the Brown operation are brilliant, but the inflamed colon cannot recover sufficiently to function, and when the intestinal tract is reestablished, symptoms of the ulcerative colitis return almost immediately.

Tuberculosis of the cecum and ascending colon is relatively common, and when occurring with other tuberculous lesions the diagnosis is easily made. Otherwise, it is distinguished with difficulty, even by the X-ray, from other ulcerating lesions of the colon. Complete excision of the ileocecal coil, even when there is a mild pulmonary infection, has given good results.

Diverticulitis, a condition peculiar to the large bowel, occurs usually in the sigmoid, and is found most often in fleshy persons. Perforation of one or more of the diverticula may occur, producing local or general peritonitis, and abscess formation. Following drainage of an abscess, a fistula may persist, requiring surgical closure of the opening in the bowel. Obstruction sometimes develops, necessitating a colostomy. Resection is hazardous, because of the infection which is always present.

Actinomycosis involves the colon occasionally, and may resemble tuberculosis or malignancy, even at operation. When found, resection should be followed by roentgen and iodide therapy, usually with satisfactory results. When abscesses have formed, the condition is more difficult to treat, with less favorable results.

Benign tumors, with the exception of multiple polyposis, are usually indistinguishable from malignancy. Proctoscopic and roentgen examinations are valuable and accurate aids in the diagnosis. When malignant degeneration is suspected, resection is indicated, instead of excision.

Cancer of the colon is seen often, although it is more common in the rectum than in any other part of the large bowel. Resections are hazardous, because often the neoplasm has extended to other tissues, with infection resulting from the perforation. Extensive resections are also dangerous because of the distribution of the blood supply, necrosis, with leakage, often occurring, especially on the left side, and sufficient drainage must always be provided. Resections of the left side of the colon should always follow a preliminary colostomy, which can be closed later.

D. B. HARDING, M.D.

A Consideration of Lesions of the Colon Treated Surgically. E. Starr Judd. Southern Med. Jour., XVII, Feb., 1924, p. 75.

Diagnosis with and without barium. — A positive diagnosis, even without the use of barium, can be made in many acute abdominal cases not ordinarily seen by the roentgenologist. Following severe trauma, a gas-filled stomach or colon may be seen above the diaphragm. In post-operative cases, an empyema, or a hepatic or subphrenic abscess can be shown when present. Even in lesions directly involving the gastro-intestinal tract, barium is not always necessary for a diagnosis. Gastric retention from an obstructive pyloric or duodenal lesion shows a typical fluid level in the stomach. Gas-distended loops of the small intestine denote an obstruction proximal to the ileocecal valve, and obstruction in the colon shows a typical fluid- and gas-filled colon above the lesion. Here an opaque

enema may be necessary, the enema being allowed to fill the colon only to the obstructing point. In cases of obstruction in which a barium meal has been given, the barium often tends to remain above the site of the lesion, repeated mild catharsis and enemas being necessary to clean out the bowel thoroughly.

Pregnancy can usually be differentiated from abdominal tumors, although pneumo-peritoneum or inflation of the colon may be required in some cases. Roentgen examination of the pelvis is essential when there has been a traumatic rupture of the urinary bladder.

D. B. HARDING, M.D.

Roentgen Aid in the Acute Abdomen. D. Y. Keith. Southern Med. Jour., XVII, Feb., 1924, p. 98.

The knee joint.—Surgery of the knee joint has been very limited until recent years. There are many monarticular affections of the knee, in which only exploration gives a definite diagnosis, and only surgery gives an effective treatment. Displacement of the semilunar cartilage provides the most common surgical indication, and removal of the cartilage gives very good results. Hypertrophy of the external semilunar, with an accompanying loud "snap" on motion, rarely requires treatment, but sometimes it is sufficiently troublesome to the patient to justify resection of the cartilage. Recurrent dislocation of the patella can seldom be relieved by conservative measures, and operative results are highly satisfactory. The only rational treatment of loose bodies, and foreign bodies giving symptoms, is removal. Benign tumors occur more frequently than is commonly known, and may cause a low-grade arthritis which cannot be diagnosed correctly without exploration. When small, removal may be easy, but they may fill the entire joint cavity, requiring complete disarticulation for removal. Enlarged villi may be resected, sometimes through a small incision, but many of these cases cannot be benefited without a rather extensive operation. Low-grade inflammatory processes, producing diffuse proliferative changes throughout the entire synovial membrane, should not be confused with tuberculosis of the joint, for a complete synovectomy may give a good result, without sacrificing the joint. In tuberculous lesions the surgical indications may be a simple arthrotomy, filling the joint with iodoform in oil, or one of the fusion operations.

Acute infections seldom require drainage when formalin and glycerin is injected, according to the Murphy technic. Gunshot wounds usually necessitate drainage. Arthroplasties for mobilization of ankylosed knees give varying satisfactory results, with sometimes an increase of motion to 90 degrees. The utmost conservatism should be practiced in the treatment of joints, the actual percentage of knee affections requiring open operative measures being very small. However, when indicated, there should be no hesitation to enter the knee joint, even for exploration.

D. B. HARDING, M.D.

Surgery of the Knee Joint. Willis C. Campbell. Southern Med. Jour., XVII, Feb., 1924, p. 82.

The gall bladder.—This article is a study of one thousand operations for gall-bladder disease which have been performed by Dr. McGuire during the past twenty years. His data confirm the accepted belief that no age is immune, and that the disease is more frequent about middle life, for he found that his youngest patient was thirteen, the oldest seventy-nine, and the average age forty-five. Seventy-one per cent of his patients were women and 29 per cent were men. All his cases were white people and he can not recall ever having operated upon a negro, other than two or three mulattoes.

He found gallstones present in 74 per cent of cases. He now removes apparently normal appearing gall bladders when there is a definite history of gall-bladder disease and there is no other pathology in the abdomen which could account for the symptoms. Only 5 per cent of the cases were acute at the time of operation. He does not believe that infection of the gall bladder presents an emergency at all comparable to infection of the appendix, and, unless a case of cholecystitis is attended by symptoms that cause alarm, he is in favor of waiting until the acuteness of the infection subsides.

The gall bladder was drained in 63 per cent of the cases and removed in 37 per cent. However, most of the cases that were drained occurred in the early part of the twenty-year period. In the past few years practically every case has had the gall bladder removed. His average mortality in this series was $6\frac{7}{10}$ per cent. Cases with stones in the common duct had a death rate of 10 per cent. But the more recent cases, where the gall bladder was removed, had a mortality rate of only $2\frac{7}{10}$ per cent.

He finds that the most prominent symptoms are indigestion; pain, located in the epigastrium and radiating to the back or right shoulder blade; tenderness over the gall bladder elicited by deep pressure; colic, abrupt in its onset and sudden in its relief; jaundice occurring on the average of once in every seven cases.

The value of X-ray findings is still a question under discussion. Conscientious radiologists claim to be able to show gallstones in only from

30 to 50 per cent of the cases where they are actually present. Some X-ray men claim that a healthy gall bladder does not show on the plate under ordinary circumstances. Therefore, if a distinct shadow can be outlined, such gall bladder should be considered diseased, as its walls are thickened or its cavity filled with pathologic material. It is possible that the technic of pumping air into the peritoneal cavity will increase the value of the X-ray as a diagnostic help.

Before operating, the patient is given a thorough examination and given treatment for any condition found that is suspicious. At operation he always inspects all the organs of the abdomen before he examines the gall bladder. He usually removes the gall bladder by dissecting it free from above downward. He drains all cases.

W. J. MARQUIS, M.D.

Opinions on Various Questions in Gall-bladder Surgery, Based on One Thousand Operations. S. McGuire. Virginia Med. Monthly, L, 1924, p. 688.

Pulmonary suppuration.—Pulmonary suppuration is an inclusive term for all non-specific suppurative processes involving the lungs or bronchi. It includes abscesses, bronchiectasis, suppurative pneumonitis, and their combinations.

Differential diagnosis must be based on the clinical aspects of the case, taking into account especially the mode of onset, the etiology, symptoms and signs, roentgenographic findings, and, in certain cases, bronchoscopic findings and clinical course. Diagnosis of typical diffuse bronchiectasis and acute localized abscess, in which the roentgenographic findings are characteristic, present no special difficulty. In the case of abscess the roentgenogram shows a circumscribed area of increased density and in some cases a fluid level. In cases of long standing in which the roentgenogram shows multilocular cavitation and in those in which there is thickening of the pleura, masking physical signs and shadows produced by pulmonary lesions, it may be quite impossible to determine whether abscess or bronchiectasis is the predominating condition. In typical bronchiectasis roentgenograms usually show a fairly normal translucency of the thorax with perhaps slightly increased density of the involved portion, especially if the pus has not been evacuated just prior to making the roentgenogram, or they may show simply an increased density and some dilatation of the involved bronchi. In many cases practically nothing abnormal is shown.

Roentgenograms in suppurative pneumonitis show a more or less diffuse shadow. Localization is uncertain or impossible.

Treatment

Acute peripheral abscess which shows progressive improvement should be treated by postural drainage. Other abscesses should be drained. Centrally situated abscesses not suitable for surgical drainage are best treated by pneumothorax therapy. Chronic abscess, if single and peripheral, should be drained, and, if healing is delayed, secondary plastic operation performed later. The greatest advance in the treatment of parenchymal pulmonary abscess will be attained by early operation, following accurate localization. Localized saccular bronchiectasis may be drained with marked improvement, so long as drainage is maintained. Extrapleural thoracoplasty is of wide application and has resulted in a relatively large proportion of cases of marked improvement, in some cases approximating cure and in the author's experience without mortality. Combined chronic abscess and bronchiectasis, especially of indeterminate grade, are relatively unfavorable to any method of treatment, but extrapleural thoracoplasty offers a fair prospect for improvement which may approximate cure.

T. S. SWAN, M.D.

The Treatment of Non-tuberculous Pulmonary Suppuration. Carl A. Hedblom. Northwest Medicine, XXIII, No. 1, Jan., 1924, p. 1.

Haudek's niche.—Haudek's niche is a departure from the normal continuous outline of the stomach which is permanent in a considerable series of observations and which is not displaced or obliterated by palpation. Such a characteristic departure may be temporary or transient, and when such is the case it is not of significance. Too often the phantom form is used to diagnosticate gastric ulcer when it is not present. In some instances the phantom form, which is only a phenomenon of peristalsis, may be permanent throughout the average length of time used in the examination of a stomach. The possibility of such a diagnostic error makes the results of medical treatment, based on the disappearance of the niche, questionable in a number of cases. From a series of thirty-nine cases, the author reports that in five cases no pathology corresponding to the niche was found at operation.

J. D. CAMP, M.D.

Defects in the Contour of the Stomach Simulating Haudek's Niche. Anthony Bassler. Amer. Jour. Roentgen., XI, Jan., 1924, p. 74.

Eventration of the diaphragm.—This very scholarly study of *eventratio diaphragmatica* in its various aspects includes six case reports of eventration and nine of phrenic paralysis, with

many illustrations. The anatomy, embryology and differential diagnosis are given special consideration.

Distinction of eventration from diaphragmatic hernia dates back to Jean Louis Petit in the eighteenth century. All the recorded cases of eventration have been on the left side, save one by Eppinger, in 1911. Fluoroscopically, the diaphragm is seen as an unbroken bow line, high in the left chest, enclosing an air space, at the bottom of which there is often a sharply defined fluid level, on which waves and ripples can be produced by palpation of the abdomen. The presence of this horizontal line depends on the amount of gastric content; but its level is always that of the cardiac orifice. All of Morison's cases showed paradoxic respiratory movement on the affected side—ascent in inspiration, descent in expiration. At times a portion of the colon lies alongside the stomach and may cause slight irregularity of the bow line. Lung tissue may or may not be seen through the air space. The heart may be displaced, or rather rotated, to the right. In nearly all cases there is well-marked deformity of the stomach, due to its ascent and rotation. It presents two sacs, the upper spilling forward into the lower. Volvulus requiring surgical intervention may occur. A history of stomach trouble is frequent.

Paralysis of the left phrenic nerve has the same radiologic characteristics as eventration. In two of Morison's cases the right diaphragm was affected. All were caused by intrathoracic lesions. Morison believes that phrenic paralysis is more common than has been supposed.

Differential diagnosis of eventration must take into account temporary elevation, diaphragmatic hernia, localized hydro- or pyopneumothorax, subphrenic or subhepatic abscess. Temporary elevation, due to gaseous distention of the stomach, varies from time to time; paradoxic respiration is absent. Diaphragmatic hernia shows a broken line. If the hernia is small, reversed movements may occur; if large, no movements take place. The fluid contents of the stomach may reach high above the cardiac orifice and Morison stresses this as a differential point from eventration. Examination with the opaque meal should rarely fail to settle the diagnosis.

The other conditions mentioned usually offer little difficulty in diagnosis.

A. MILLER, M.D.

Elevation of the Diaphragm: Unilateral Phrenic Paralysis. A Radiological Study, with Special Reference to the Differential Diagnosis. J. M. W. Morison. Arch. of Radiol. and Electrother., XXVII, 1923, pp. 353-364; XXVIII, pp. 72-83 and 111-118. Available also as a 30-page brochure from William Heinemann, Ltd., 20 Bedford St., W. C. 2, London.

Technic of irradiation for cancer.—The authors think that cases are now sufficiently numerous to enable a distinction to be made of those cases which are amenable to deep irradiation and those which at least up to the present time have not given a sufficient result. Perhaps in the future cases which are now unfavorable will react more favorably to deep radiation. Technic is evidently not everything and there will always be numerous cases of cancer against which the best technic will be powerless. But the authors are convinced of what improvements in technic can do. It has not been possible for them to cause the disappearance of laryngeal cancer by employing the German technic, but they have easily succeeded by employing a technic analogous to that recommended by Regaud. The German technic is good only for very radio-sensitive cases. It is of no value in cases which are only slightly radio-sensitive and the authors have abandoned it. In 100 cases treated by deep irradiation, the authors have succeeded in obtaining complete disappearance of the tumor in the following cases: 1 case of sarcoma of the tonsil; 1 lymphosarcoma of the rectum; 1 case of seminola; 1 case of scirrhous cancer of the breast; 3 axillary metastases of epithelioma of the breast; 1 supraclavicular mestatasis of a spinocellular epithelioma of the breast; 1 globular epithelioma of the submaxillary region; 1 case of bladder cancer; 2 cases of spinocellular cancer of the larynx.

The authors prefer to use the term "disappearance of the tumor" rather than "recovery," as their results are not more than ten months old, and recovery from cancer in so short a period cannot be spoken of, as cancers of the tongue or breast are often seen to recur ten to twelve years after operation. But in the cases mentioned above the examination showed complete disappearance of the tumor.

The authors employ the Gaiffe apparatus.

Regarding the calculation of deep dosage in percentage terms of the so-called erythema dosage, the authors have on investigation found this illusory. Quite apart from the difference in sensitiveness of different cutaneous regions there are enormous differences between one individual and another.

With the Gaiffe apparatus by placing the tube at 40 cms. from the skin erythema is as a general rule obtained in 6 hours with a filter of $\frac{5}{10}$ zinc plus 1 mm. of aluminum. With a zinc filter, 1 mm. thick plus 2 mm. of aluminum, erythema results in 10 hours and radiodermatitis in 15 hours (40 cm. spark and $2\frac{1}{2}$ milliamperes intensity). But these findings vary enormously with individuals. Erythema cannot be defined exactly, and a biologic phenomenon of such variability cannot evidently be employed

seriously as a unit for physical and mathematical calculation of the deep dose which, according to the German technic, goes to the second decimal place. Another defect of the German method is the application of the entire dose in one day. The authors' cases of laryngeal cancer prove that the applications ought to have a certain duration in order to be efficacious. In these cases with the Gaiffe apparatus the authors used a spark equivalent to 40 cms.; filter 1 mm. zinc plus 2 mm. aluminum; intensity 2½ ma., two lateral portals of entry, one right and one left; anticathode skin distance 40 cms. Duration of application, 15 hours on each side, 30 hours in all, the dose being applied in 8 to 15 days. Result, complete disappearance of the tumor.—*Results of Deep Roentgen Therapy of Cancer (Résultats de la roentgenthérapie profonde du cancer). A. Gunsett and D. Sichel. Jour. de Radiol. et d'Elect., VI, 1922, p. 453.*

Hyperthyroidism. — The author deals only with the X-ray treatment of hyperthyroidism. He discusses the different types of goiter briefly and compares surgery to X-ray therapy. Two illustrative cases are discussed. The following conclusions are given:

The author emphasizes that all cases of colloidal cystic, simple goiters, non-toxic adenomata and those causing deformity and pressure symptoms should never be treated with the X-ray, but treated with surgery when the occasion demands intervention.

Many cases of exophthalmic goiter and toxic adenomata with hyperthyroidism can be offered permanent cures, and others greatly improved by X-ray therapy. However, should improvement not be noted in three months, further X-ray therapy should be abandoned and an operation advised.

The closest co-operation between the internist, surgeon and roentgenologist should be maintained in handling these cases. Repeated and careful basal metabolism tests should be made before, during and after X-ray treatment.

The manner of giving the treatments consists usually in exposing three areas over the thyroid, using 5 ma., 6 mm. of aluminum filter, 9-inch spark gap, 8-inch distance and 5 minutes' time over each area.

W. J. Marquis, M.D.

Roentgen-ray Treatment of Hyperthyroidism. I. T. McKinney. Virginia Med. Monthly, L, 1924, p. 709.

Roentgen examination of stomach and duodenum.—A thorough, careful roentgen examination of the stomach and duodenum will reveal the presence or absence of organic lesions in 90 to 95 per cent of cases. This is especially valuable for two reasons: First, gastric symptoms may be present in a great number of cases in which the stomach is entirely normal, although there may or may not be organic trouble elsewhere. Second, in those cases in which a gastric or duodenal lesion is present, without a typical history, the diagnosis made evident. The great advantage of the roentgen examination lies in the objective and definite nature of its findings. However, a very thorough knowledge of all the normal variations is absolutely essential, and the lack of this knowledge constitutes the source of most errors in diagnosis. Fluoroscopy, permitting inspection at various angles, and allowing palpation to determine mobility and flexibility and to rule out spasm, is probably the more satisfactory method of examination. The gall bladder, terminal ileum, appendix, and colon should be examined routinely, the colon sometimes requiring an opaque enema.

D. B. Harding, M.D.

The Value to the General Practitioner of X-ray Examination of the Stomach and Duodenum. A. Henriques. New Orleans Med. and Surg. Jour., LXXVI, Feb., 1924, 368.

Intracranial conditions and treatment.—The necessity for more efficient methods of diagnosis of intracranial conditions is obvious to everyone concerned in the matter. The authors have had the opportunity of examining a series of 14 cases by the Dandy method of spinal air injections in the Baylor Hospital, Dallas, Texas. The results have been very satisfactory and there have been no mishaps. The Dandy technic was used. Patients suffer some discomfort such as headaches, severe at times, but the unpleasant symptoms disappear within 24 hours. There may be a marked rise in the temperature.

With regard to the selection of cases, the most important contra-indication is a brain tumor in the posterior fossa, as removal of spinal fluid in such a case may be fatal. Infectious and hemorrhagic conditions have also been mentioned as contra-indications. The method appears to be of the greatest value in studying cases of hydrocephalus where it is of importance to definitely locate the point of obstruction.

For comparative study of the intracranial passages the authors give some roentgenograms of normal brains and explain the origin and distribution of the spinal fluid. It is Dandy's opinion that the normal sulci should always fill and that the absence of such fillings indicates a blocking of either the basilar cisterns or the sulci themselves. In the authors' series of 14 cases the sulci were well filled only 4 times, whereas

the ventricles were filled 10 times. In 4 cases there was some questionable filling of a few of the sulci. Since the ventricles appeared normal in most of the cases in which the sulci did not fill, there probably was no hydrocephalus present. A failure of the sulci to fill does not, therefore, seem always to indicate a blocking of these structures.

Three of the authors' series of 14 cases which were considered definitely pathological are described and illustrated with the roentgenograms. The first was diagnosed as a hydrocephalus of the communicating type, the ventricles being filled with spinal injection. The second case was diagnosed similarly. The third was a case of internal hydrocephalus probably caused by a midbrain tumor. The aqueduct of Sylvius appeared to be obstructed.

In their summary the authors say that injection of the subarachnoid space with air appears to be a relatively safe procedure where the cases are properly selected. The after-effects of the injection are not serious. The proper interpretation of roentgenograms of the skull made following such injections should aid materially in improving the mortality statistics now credited to brain surgery.—*Roentgenography of Intracranial Passages Following Spinal Air Injections. C. L. Martin and C. Uhler. Amer. Jour. Roentgenol., IX, 1922, p. 543.*

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